THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

[Registered as a Newspaper.]

Vol. XXXII. No. 816.] LONDON, DECEMBER 31, 1878. [30th Year.] Price 6d.

COOKE BROS.

See Page 968.

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GENUINE TORBAY PAINT
And SPECIAL GASOMETER PAINT.
Several Prize Medals. Established over 20 Years.
These Paints are now used in over 200 Country Gas-Works, and by all the London Gas Companies, on Gas-holders, Scrubbers, Purifiers, &c. Also used by the Admiralty, War Office, Railway Companies, Founders, &c. They prevent and arrest rust, and protect iron from the action of water, sulphurous and gaseous exhalations; do not crack, blister, or flake off; will cover tar effectually.
The covering powers are considerably greater than those of any other Paint.—*See "Engineer," Nov. 2, 1866.*
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CONTRACTOR FOR
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FOR
Gas, Water, & Sanitary Purposes,
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WOOD GRIDS
FOR
SCRUBBERS AND PURIFIERS.

COWEN'S PATENT FIRE-CLAY RETORTS.
JOSEPH COWEN and CO.,
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J. C. and Co. have been for many years the most extensive Manufacturers of Fire-Clay Retorts and Fire-Bricks in the Kingdom. Orders for Fire-Clay Retorts of all shapes and dimensions, and to fit any shaped Mouthpiece, Fire-Bricks, and every other article in Fire-Clay, are promptly executed at their Works as above.
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Manufacturers of
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Manufacturers of
WET AND DRY GAS-METERS,
Licensees and Manufacturers of
HUNT'S
PATENT COMPENSATING METERS,
STREET-LAMPS, &c., &c.
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TELESCOPIC & SINGLE GASHOLDERS,
CAST & WROUGHT IRON TANKS FOR DITTO,
And Gas Apparatus of every Description.
Marine, Tubular, Cornish, Plain, Furnace, Saddle, and Range Boilers.
Sugar, Saltpetre, and all kinds of Pans.
Roofs, Girders, and Bridges, and General Smith's Work.

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ERECTION AND REBUILDING OF GAS AND WATER WORKS.
ESTIMATES FREE
FOR MAIN-LAYING AND GENERAL REPAIRS
RETORT-SETTING A SPÉCIALITÉ.
ROBUS'S IMPROVED RETORT-SETTINGS guaranteed to carbonize a large amount of coal with a small per cent. of fuel.
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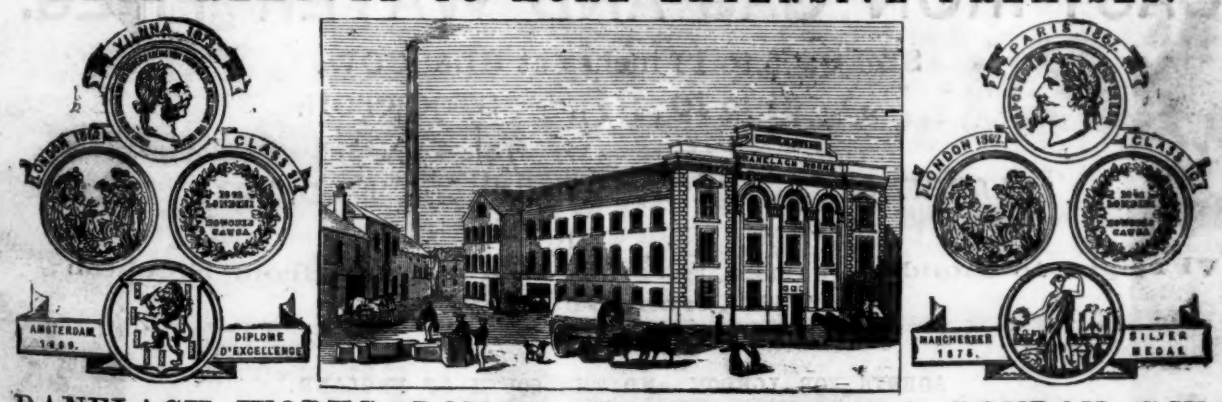
CHANGE OF ADDRESS.
GEORGE GLOVER AND CO.,
DRY GAS-METER MANUFACTURERS,
HAVE REMOVED TO MORE EXTENSIVE PREMISES:



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THE UNVARYING WATER-LINE GAS-METER,

AND

IMPROVED DRY GAS-METERS;

STATION-METERS OF ALL SIZES, with PLANED JOINTS;

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And all kinds of Experimental Gas Apparatus.

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SIZES: ¾ to 12 inches at GLASGOW.
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A LARGE STOCK KEPT, AND PRICES MODERATE.

Freight to London, in the Stream, 10s. per ton from Stockton;
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HOYLAND SILKSTONE COLLIERIES,

Near BARNSLEY.

This Company is now in a position to raise **2000 tons per day of REAL OLD SILKSTONE GAS COAL.**

"The quality of this Coal for Gas purposes, if equalled, is not excelled by any on record, and the Coke competes successfully with best Durham."—See *Mining Journal*, Aug. 11, 1877.

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Effecting a great saving in the cost of discharging Coals from Vessels, Barges, &c. Several of these Cranes, with the necessary power, are now being erected at the Beckton Gas-Works.

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Sixteen recently erected at Beckton, applied to Covers 30 feet square.

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WEST'S GAS IMPROVEMENT COMPANY,

LIMITED,

ARE NOW PREPARED TO SUPPLY AND ERECT THEIR PATENTED MACHINERY FOR

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And to enter into arrangements with GAS COMPANIES for its use upon moderate terms of Royalty.

The Patented Machinery has secured the approbation of all Engineers who have visited the MAIDSTONE GAS-WORKS, *where it is in full operation, and may be inspected at any time on application to the Manager.*

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WORKS: COMMERCIAL ROAD, EXETER,

INVITE THE ATTENTION OF GAS COMPANIES AND OTHERS FOR THE SUPPLY OF

EVERY DESCRIPTION OF GAS APPARATUS.

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NEW GAS-WORKS erected complete. Plans and Estimates furnished. MAINS, METERS, SERVICES, LAMPS, &c., adapted for Towns of any size. Gas Companies advised on Improvements, Extensions, and Alterations of Works.

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They beg special attention to the excellence and superiority of their WET and DRY METERS, several thousand being now in use by many of the largest Gas Companies in the West of England and South Wales. Warranted to measure correctly, and not to vary. Their acknowledged superiority has brought them into general use more rapidly than any Meters hitherto manufactured. A guarantee of Five years tendered with each Meter.

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An extensive variety of Choice Designs in CHANDELIERS, PENDANTS, BRACKETS, STAR and SUN LIGHTS, MEDIÆVAL FITTINGS for CHURCHES, &c.

PATTERN-BOOKS and PRICE LISTS furnished.

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THE

STANDARD WASHER AND SCRUBBER.

[KIRKHAM, HULETT, AND CHANDLER'S PATENT.]

Some of the advantages claimed for this Apparatus are as follow:—

The Exposing of a large Amount of Effectually-wetted Surface (which is continually reproduced) to act upon the Gas.
Unerring Regularity in the Distribution of the Liquor.
Saving of Expense in Providing and Exchanging Scrubbing Material—none being required.
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Economy of First Cost and of Maintenance.
It works without Pressure.
It is particularly adapted for Gas-Works where Sulphate of Ammonia is manufactured.

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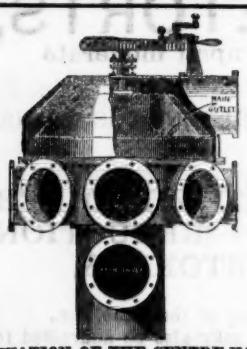
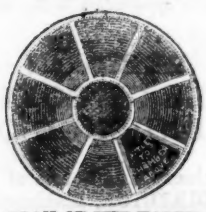
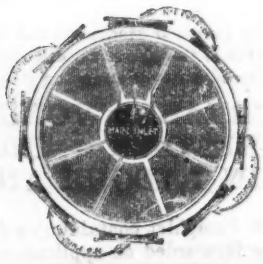
C. & W. WALKERS'
PATENT CENTRE-VALVES.



ELEVATION OF THE CENTRE-VALVE.



PLAN OF THE VALVE.



PLAN OF THE BODY.

These PATENT CENTRE-VALVES are the most perfect and certain means for working Purifiers on the system of three in action, and one out of action. The Valve itself is protected from all injury inside the safety cover. The working of the Valve is so easy, and so governed by the stop-catch movement, that the Purifiers can be instantaneously changed in the dark as well as in daylight. They are scraped perfectly true, metal to metal, the facings heretofore exposed are always covered, and there is nothing more reliable, certain, and durable in a gas-works. By their use the floor of the Purifying-house is clear and level; the Valve and all connexions being beneath the floor, out of the way of working. A considerable improvement and saving is effected in the cost of the connecting-pipes.

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APPARATUS CONNECTED WITH GAS-WORKS.

THE ORIGINAL PATENTEES AND MANUFACTURERS OF THE

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FOR PURIFIERS, GASHOLDERS, BYE-PASS, AND OTHER ARRANGEMENTS REQUIRING VALVES IN GAS-WORKS.

The Faced Valves, as made by the Patentees, continue to give great satisfaction, and they are being used extensively by many of the best gas engineers of the day.

They are more easily repaired than any other kind of Valve in use, and can be re-ground in a few hours without removal, and made perfectly gas-tight.

References can be given to many Engineers of high standing, who will testify as to the favour in which they are held.

MANUFACTURERS ALSO OF SUPERIOR WOOD GRIDS FOR PURIFIERS, SCRUBBERS, &c.

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And every Description of Gas Apparatus.

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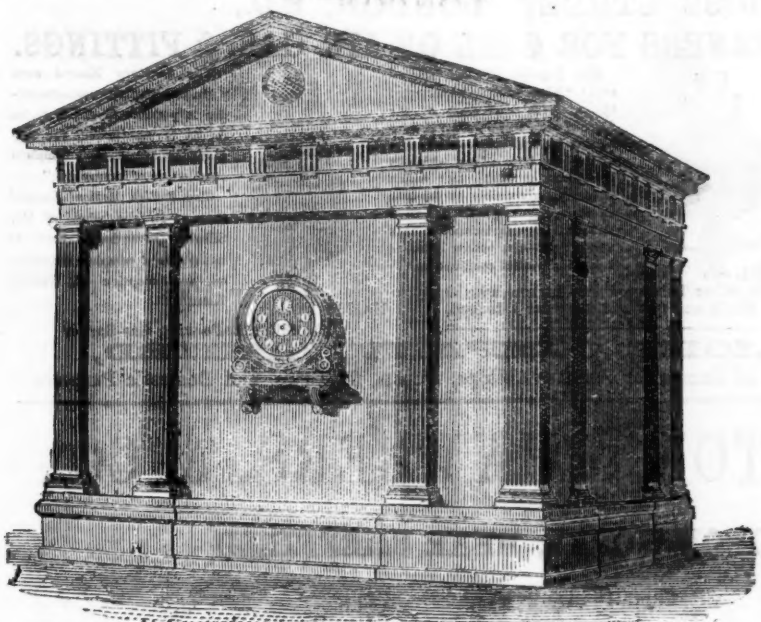
OF THE HIGHEST EXCELLENCE ONLY;

ALSO LICENSEES AND MANUFACTURERS OF

WARNER & COWAN'S PATENT SELF-REGULATING GAS-METERS;

ROUND STATION-METERS,

ON CAST-IRON STANDS.



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GAS COOKING APPARATUS.

Home and Foreign Orders promptly attended to.

All Sizes of CONSUMERS METERS, STATION-METERS, and GOVERNORS generally in Stock.

Orders almost invariably despatched on the day of receipt.

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Which have now been used for fifteen years, and their advantages and durability fully established. They are made entirely by steam machinery in very large quantities at the most moderate cost.

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ESTABLISHED IN 1860.

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FOR

GAS PURIFIERS & SCRUBBERS.

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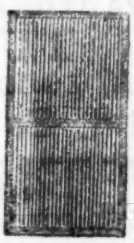

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WITH TAPER BARS,

MADE BY MACHINERY

CAPABLE OF MAKING 10,000 PER WEEKLY.

References to Hundreds of First-Class Engineers.

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Plans and Estimates furnished; Gas-Works, Apparatus, Pipes, Machinery, Fire Goods, &c., supplied, or Attested and Shipped for Exportation.

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Mr. ROMANS has for upwards of 30 years been practically engaged in the Manufacture of Gas, and has, by extensive experiments, ascertained that by JUDICIOUS INTERMIXTURE of the lighter with the heavier gases, much of the rich Hydrocarbons CAN BE SAVED, which otherwise ARE LOST, during the process of manufacture. He is therefore enabled to give advice to those who favour him with their orders for Cannel, as to the class which will secure for their standard of illuminating power the HIGHEST ADVANTAGEOUS RESULTS.

ANALYSIS AND PRICES FORWARDED ON APPLICATION.

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PORTABLE PIPE SCREWING

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For 1 in., 1¼ in., 1½ in., and 2 in. Gas Threads, complete £7 10s.

In use at the chief gas-works, and giving great satisfaction.

For other useful goods, see Bailey's "Illustrated Inventions," post free 3s. 6d.; gratis to ledger customers.

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The only Gold Medal awarded for "Apparatus and Processes for Heating and Lighting" by the Imperial Commissioners

MEDAL FOR PROGRESS, VIENNA, 1873.

The following Medals were also awarded at Paris, 1878:—

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GOLD MEDAL (Rappel) for Metallic Bedsteads and Furniture.

GOLD MEDAL (Rappel) for Art Metal Work. BRONZE MEDAL for Tube Metal and Wire.

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ROLLED METALS, LOCOMOTIVE AND CONDENSER TUBES, CYLINDERS;

Ornamental, Taper, and Cased Tubes; Tin Tubes;

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BRACKETS FOR HEATING AND LIGHTING;

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Ecclesiastical and Mediæval Metal Workers.

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Manufacturers of SILBER BURNERS FOR COAL OR AIR GAS, & FITTINGS.

No. 285.

The Silber Tubulated Gas-Burner.

The *World* says: "The light given by these Burners, besides being abundant in quantity, is almost like sunlight in its quality, so that it produces the same spectrum when refracted through a prism, and allows even the most delicate shades of colour to be distinguished."

Dr. W. WALLACE, F.R.S.E., F.C.S., says: "It gives the steadiest flame of any Argand yet constructed."—*Vide* Report presented to the Dublin Meeting of the British Association, Aug. 15, 1878, "On the Best Means for the Development of Light from Coal Gas of Different Qualities."

No. 291.

The Silber Tubulated Gas-Burner, with Opal Shade and Cup and Governor attached.

The *London Medical Record* says: "This uniform blending of the air with each part of the flame results in rendering it pure and white, and very considerably lessens the blue colour, which is significant of waste, and which is very plainly visible at the base of all imperfect lights. The creation and the maintenance of this white light—not yellow light—is a proof of perfect combustion.

No. 286.

The Silber Bat's-wing Gas-Burner

The *Sanitary Record* says "Mr. Silber's improvements render it possible to eliminate, as far as is practicable, the sulphuric acid due to the incomplete combustion of impure gas."

The *British Medical Journal* says: "In the whole of Mr. Silber's inventions there is noticeable a complete attention to, and adoption of, natural laws."

THE SILBER LIGHT COMPANY, LIMITED,

Are also Manufacturers of every description of Lamps for Railways, Ships, Streets, Churches, and Domestic Purposes.

MESSRS. NEWTON, CHAMBERS, & CO.,

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MANUFACTURERS OF

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And every description of Gas Machinery.

TENDERS GIVEN FOR WORK FIXED COMPLETE IN ANY PART OF THE KINGDOM.

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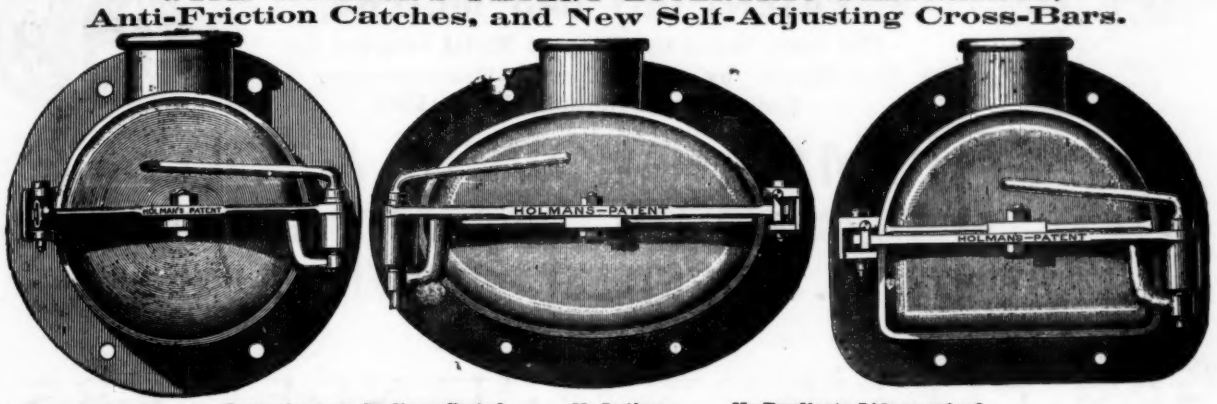
(LATE OF 10, LAURENCE POUNTNEY LANE.)

SOLE MAKERS OF MORTON'S PATENT SELF-SEALING RETORT-LIDS,

WITH HOLMAN'S PATENT ECCENTRIC FASTENINGS,

Anti-Friction Catches, and New Self-Adjusting Cross-Bars.



Instantaneous Sealing effected. No Luting. No Duplicate Lids required.

Holman's New Self-Sustaining Cross-Bar ensures freedom of Joint, and maintains parallel position of the Lids.

Since their introduction in 1869, these Patent Retort-Lids have been thoroughly tested, being now in use in nearly all the principal Gas-Works in London and the Provinces.

T. B. and H. are now making the "Morton's Self-Sealing Lid" of the SAME FORM OR SECTION AS THE RETORT (see Illustrations above), as well as bringing the Mouthpiece from the D or Oval at back to Circular in front, as heretofore.

D and Oval Morton's Lids are working satisfactorily both in this country, on the Continent, and in the United States of America. Among others they have been adopted by the following Gas-Works:—

The Gaslight Company's Works, Fulham; Ditto, Bromley-by-Bow; Ditto, King's Cross; Ditto, Shoreditch.
And also in the Gas-Works at Richmond, Maidstone, Gloucester, Glasgow, Portsea, Roubaix (France), The Hague (Holland

HUNT'S PATENT EQUILIBRIUM GAS-GOVERNOR.

In this Governor a Throttle-Valve is substituted for the ordinary suspended Cone, all external communications being avoided by placing the Lever or Radius Arm (shown in the drawing) inside the Valve-Chamber upon the Disc. The Disc is carried upon steel centres, upon which it is accurately balanced and turns freely. The friction in working is thereby reduced to a minimum. This Governor is extremely sensitive to alterations of inlet or outlet pressure, and renders a large actuating holder unnecessary.

The principal advantages of this arrangement over the ordinary form of Governor are as follows:—

Its sensitive action prevents oscillation.

It is self-adjusting—*i.e.*, it maintains a steady pressure under variations of inlet pressure or a fluctuating consumption.

The inlet to Gasholder being contracted to the smallest possible dimensions, all danger from leakage through insufficiency of seal, tilting, &c., is entirely avoided.

The valve portion being separate from the holder, it can be handled and fixed like an ordinary Slide-Valve direct in the main; and the holder can be placed at an convenient distance immediately above it. The cost is thus materially reduced, and the inconvenience of heavy lifts done away with.

There are no working parts likely to get out of order.

These Governors have been adopted by many leading Gas Companies, among whom are the following:—

The Gaslight and Coke Co. (2), The London Gas Co. (3), and at Abergavenny, Arundel, Birmingham, Cannes (France), Devonport, Dursley, Exeter, Guernsey, Halesowen, Mentone (France), Monmouth, Newcastle-on-Tyne, Oxford, Plymouth, Rochdale, Windsor, &c.

TESTIMONIAL.

The Gaslight and Coke Company,
9, Water Street, New Bridge Street,
Blackfriars, E.C., Feb. 27, 1875.

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Gentlemen,—The two 24-inch and three 36-inch Hunt's Equilibrium Governors supplied by you, and fixed in the valve-rooms at Whitechapel, Goswell Road, and Blackfriars, are working very satisfactorily.

Yours truly,

(Signed) JOHN JOHNSON.

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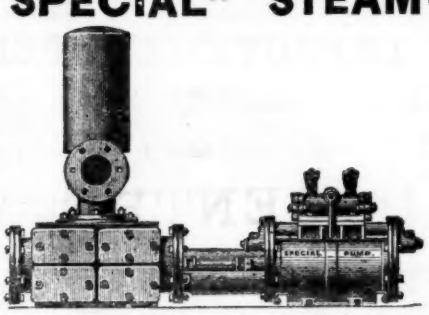
THE "SPECIAL" STEAM-PUMP.

Diameter of Steam Cylinder.	Diameter of Water Cylinder.	Length of Stroke.	Gallons of Water per Hour, Approximate.	Reduced Prices.
3	1½	9	450	£16
4	2	9	815	18
5*	2½	12	1,250*	20
5*	3	12	1,830*	22 10
4	4	12	3,250	25
6*	4	12	3,250*	30
5	5	12	5,070	32 10
7*	5	12	5,070*	40
6	6	12	7,330	40
8*	6	12	7,330*	50
7	7	12	9,750	50
10*	7	12	9,750*	65



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Two Hundred Sizes made. Those in Table opposite are the leading Sizes for use in Gas-Works and Chemical Works.

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PATENT DRY GAS-METERS,

The latter being the Highest Medal awarded for Dry Gas-Meters by the Imperial Commissioners for the Universal Exhibition, Paris, 1867.

Paris, 1867.

THOMAS GLOVER & CO.,

DRY GAS-METER MANUFACTURERS,

214 TO 222, ST. JOHN STREET, CLERKENWELL GREEN,

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THOMAS GLOVER & CO.'S PATENT DRY GAS-METERS

1st, Are a remedy for all the defects of Wet Meters;
2nd, Are suitable for all climates, whether hot or cold;
3rd, Incur no loss of Gas by evaporation;
4th, Cannot become fixed by frost, however severe;
5th, Are the most accurate and unvarying measurers of Gas;
6th, Prevent jumping or unexpected extinction of the Lights;
7th, May be fixed either above or below the level of the Lights;
8th, Cannot be tampered with, without visibly damaging the outer case;
9th, Will last much longer than Wet Meters;
10th, Will not cost more than one-half for repair that Wet or Water Meters do;
Are upheld for five years without charge.

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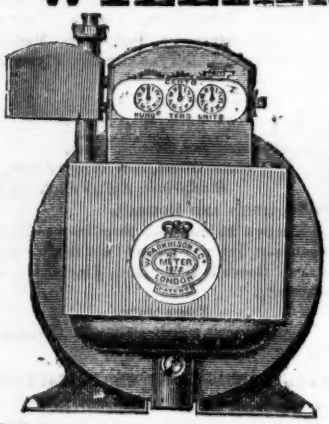

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MANUFACTURERS OF

WET & DRY METERS,

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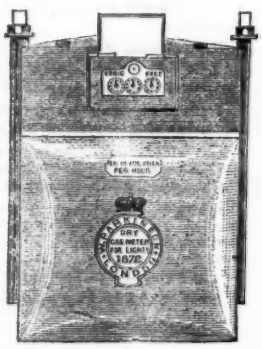

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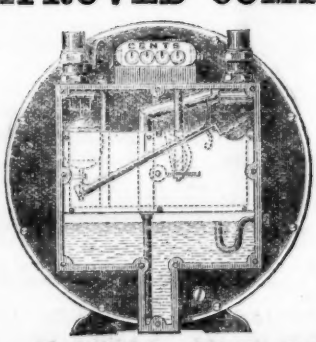
In this Meter, the action of the measuring-drum is reversed. By this arrangement an improvement is effected in the registration at high speeds, which, in many tests, has not varied from the smallest light to three times the capacity of the meter. It works equally well under all pressures. The range of error between the high and low line is much smaller than that allowed by the "Sale of Gas Act."



The Meter has been critically tested, and most favourably reported upon by official Meter Inspectors in London and Birmingham.

W. PARKINSON and CO. have made arrangements for the manufacture of these Meters, both in tin and cast-iron cases, and for the alteration of old ones to this principle, which is confidently recommended as possessing every quality that can be desired by Gas Companies, Corporations, or Private Consumers.

COTTAGE LANE, CITY ROAD, LONDON, E.C.

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TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, DECEMBER 31, 1878.

Circular to Gas Companies.

The electric light has for so long formed the leading topic of our "Circular," that we may as well commence this week with a short notice of the Bills which two Companies, "The Electric "Lighting Company, Limited," and "The National Electric "Light Corporation, Limited," intend to promote in the coming session of Parliament, to obtain statutory powers. The two Bills much resemble each other; both ask for almost unlimited authority for the breaking up of every conceivable thoroughfare, and for fixing posts for the conveyance of wires where underground work would not answer their purposes, the only limitation, as far as we can see, being the interference with the rights of the Postmaster-General. We miss, in these Bills, any allusion to the charge which the Companies may be allowed to make for the light they would supply, or to the dividend they may be allowed to pay. As the Bills stand, they cannot be considered inimical to the interests of Gas Companies; but it is, in some respects, to be regretted that the privileges asked by the new Companies are not more fully defined. Everybody knows that Gas Companies are tied down, by all sorts of pains and penalties, to supply an article of a given quality. Who is to decide when an Electric Light Company fail in their obligations to the public? Either of the Companies whose Bills we are noticing may make a contract with a Vestry or District Board to illuminate public thoroughfares. The illumination, as is known, will be effective so long as the machinery is in perfect order; but it is also known that the delicate apparatus is liable to sudden derangement; and what if a thoroughfare be unexpectedly plunged in darkness? Gas Companies are answerable for such mishaps, and why should an Electric Light Company be entirely absolved from the consequences of a failure? The Bills, which will be further noticed hereafter, appear to us, as they stand, to have been drawn in a very crude form; but this is, perhaps, unavoidable, when an entirely new industry is started. Something more must inevitably be proposed. We wish to know the power of the light which these Companies intend to supply; we want, further, to be told upon what principle they will charge for the light; and, thirdly, it is essential that we should be informed what profits the Companies will be allowed to make. It will be observed that both Companies are "limited," and perhaps it is well for the Shareholders that this should be so. The above are the only Bills promoted by Electric Light Companies pure and simple. What chance they may have of passing, when they come before a Committee of either House of Parliament, we cannot guess. It appears to us that they have been drawn without a full consideration of the conditions which must obtain, if ever the electric light become an established institution. As experimental measures, they look very well. Committees, inspired by competent authorities, may mould them into shape, and settle what special enactments may be necessary; but, as they are put forward now, we expect that they will stand over for the consideration of another Parliament.

Some Gas Companies are going in, to a limited extent, for the privilege of supplying the new illuminating agent. They propose, however, to do even more, and, in the event of their success in obtaining the powers they ask, this may turn out, to a much greater extent, to their profit. The Gaslight and Coke Company, for instance, are applying for power to "manufacture, "provide, purchase, sell, and lend, or let for hire, any gas and "other fittings, engines, stoves, pipes, and other appliances for "motive power, or lighting, warming, or ventilating houses and "buildings, for the cooking of food, and for all or any other "purposes for which the consumption of gas, or any product "obtained in the manufacture of gas, can or may be used." This provision, which is very properly brought forward, includes a little too much. A strict reading of the section we quote would give the Company a monopoly of the use of coal-tar products for heating and illuminating purposes. For this, we are certain, the Company never intended to apply, so we pass it by, as the alteration of a few words will set the matter right. The really ostensible object of the Bill is to give the Company power to manufacture, hire, sell, or let, every kind of apparatus which can be required for any trade or domestic purpose.

The Bill promoted by the London Gaslight Company is similar, but somewhat wider in scope. The Crystal Palace District Company go further. While asking for power to furnish, sell, and let for hire, all the appliances necessary for the consumption of gas for economic purposes in residential establishments, they go a step beyond, and seek to have the right (but not exclusive) to let for hire, or sell, engines and machines, the motive power of which is obtained from gas, for the production of light other than that produced by the direct combustion of gas.

The Alliance and Dublin Consumers Gas Company, who promote a Bill to which we shall have to make further reference hereafter, propose to acquire power to supply light other than that produced by gas. What the designs of the Company are, the Bill, in its present state, does not disclose; but, as a matter of course, we presume that their object is to obtain power to furnish illumination by means of electric force. The Company urgently require means for the cheap and ready transit of coals from the quays on the Liffey to their works, and power to construct tramways for the purpose are sought in their new Bill.

The Bill which the Liverpool Corporation intend to promote consists of forty clauses, and is to confer power upon the Corporation to purchase the undertaking of the Liverpool United Gas Company, upon such terms as may be agreed upon, or settled by arbitration. The Company, we believe, have no desire to part with their property, and when this Bill gets before Committee, we expect it will be stoutly contested. The Corporation further wish to obtain power to supply the electric light, but apparently not on a very large scale, for they only ask to borrow £50,000 in respect of this part of their business. As the Bill contains the first attempt to settle a charge, or rather a mode of charging, for the electric light, we here quote a part of the section:—"The rent or sum to be charged by the Corpora- "tion for a supply of light, for domestic purposes, to any house "or premises, shall not be greater than the average rent or sum "which has been charged for a supply of gas to similar premises "on the average of three years before the commencement of this "Act, and such average shall be computed according to the "rents or sums charged for the supply of gas to premises of the "same or similar rateable value in the borough." We leave our readers to make the best they can of this novelty. A charge for light, based on the rateable value of the premises, is, at all

events, new to us. So is the idea of lighting up a shop, warehouse, or factory at a cost computed on the average of three years gas consumption. The joke is that nobody at the present time knows exactly what the electric light costs, and that the Engineer to the Corporation, as will be seen in another column, expresses a strong opinion that the expense of its generation and distribution far exceeds that of gas. The Bill is a very important one, and will receive further notice on a future occasion.

Going back to some of the measures now cursorily noticed, we may mention two things which appear to us of extreme importance. One is the proposal to make the consumer responsible for the state of his fittings. If these Bills be passed into Acts, he will be required to keep his service-pipes and interior fittings in perfect order; and if that rule be strictly enforced, all complaints about abnormal consumptions will cease. The other point is, that the fittings let out on hire by the Gas Companies must, like meters, be exempt from distress for rent, or in case of bankruptcy. The former we consider the more important of the two proposed enactments. It is of the utmost consequence, for the consumer's own protection, that his fittings should be kept in complete order. Our columns this week bear records of the frightful effects which may result from leakages of gas. Lives are sacrificed, and property is destroyed, in consequence of small leakages, which may go into the consumer's bill, or may be charged to the Gas Company. All we wish to see is an effective control kept by the Companies over the apparatus which conveys the gas from the meter to the several parts of a house. It would require some trouble for the first twelve months, but we are quite certain that consumers would soon appreciate the benefits and security that would ensue from the intelligent and careful supervision of the apparatus by means of which gas is distributed.

A correspondent in our present number calls attention to a matter which we regard as worthy of consideration He notices that, at the present juncture, it is to the interest of Gas Companies to promote the use of gas in all directions, and nothing looks more promising than its application to the production of motive power; yet he points out that the Companies do not avail themselves of the material which lies ready to their hands, and costs but little. They should set a good example, by employing gas-engines wherever motive power is required in works. Perhaps our correspondent a little exaggerates the economy to be effected by the use of a gas-engine; for it must be remembered that Companies have coke as well as gas on their hands.

The Town Council and the Ratepayers of Exeter do not appear to be exactly agreed as to the advisability of purchasing the gas-works. The Council having consulted Messrs. Quilter, Ball, and Co., Accountants, and Mr. Arthur Silverthorne, C.E., who have reported favourably on the present financial position and future prospects of the Company, unanimously resolved to recommend their constituents to vote for the purchase of the works at the forthcoming poll. But, at an informal town's meeting recently held, resolutions condemning the purchase were also unanimously passed by the assembled ratepayers. Perhaps, on the one hand, the Council take a too sanguine view of the matter, while most certainly their opponents take too gloomy alone. The purchase on the terms indicated could not be a bad one for the Corporation; but, as all our readers know, we are utterly opposed to the transference of commercial undertakings to corporate authorities.

The Corporation of Manchester have resolved on imitating South Shields, Birmingham, Huddersfield, and other places too numerous to particularize, by having an exhibition of gas appliances of economic use for domestic and manufacturing purposes. We congratulate the Gas Committee of the Town Council on their resolution, and shall expect to find, when we visit Manchester, the best display of apparatus which has ever been collected together. We may here call attention to a suggestion made in our columns a week or two ago, that further encouragement should be given to the invention and manufacture of gas-engines of larger power than have hitherto been made. The Corporation of Manchester would do well, as the Local Authority of a city in which gas is largely used for industrial purposes, and in which it is to their interest to promote, as much as possible, its extended use, to encourage inventors to come forward with good strong engines for the production of motive force.

At this season of the year, whenever a hard and lasting frost occurs, we are always assailed with complaints of "frozen "meters," and the charge is always laid at the door of the Gas Companies. And, remotely, the accusation is correct; for if the placing of meters were left entirely to the discretion of the Companies servants, they would seldom be located in situations where they would get frozen. At the present time, Companies can exercise very little authority over the placing of meters. We hope the day will come when they will be able to indicate decisively where a meter should be situated; but we shall be told that such authority can only be exercised by the local governing body. In the meantime, for the information of any intelligent gas-fitters, we may mention that the addition of a little glycerine or methylated spirit will effectually prevent the freezing of the water in a meter, if the consumer be so parsimonious that he will not adopt the suggestion of a correspondent, and keep his meter in action by burning a little gas continuously. There is, however, a very simple way of getting out of difficulties of this kind, and that is by using dry meters. But here we approach very delicate ground, on which, for the moment, we shall not trespass.

Water and Sanitary Notes.

It is satisfactory to find, from the reports of Dr. E. Frankland and Major Bolton, that the Metropolitan Water Supply continues in a very satisfactory state. The River Companies, as we may call them, have great difficulties to encounter; but even with these, as illustrated by the New River and East London Companies, who take the greater part of their water from the Lea, we find a very substantial improvement on the past condition of affairs. The Thames Companies have been scarcely less successful in their purification. The high rate of impurity ascribed to the Southwark and Vauxhall Company must be attributed to accidental circumstances, for the Company are doing their utmost to effect the complete purification of their water supply. All that need be said is this, that the inhabitants of the Company's districts are in excellent health, and what more can be wanted, in these days of singularly unsettled weather, we do not know.

The Bootle well at Liverpool, which we are half afraid to refer to, does not hold out the promise which heralded the birth of the deepened bore. The yield of water continues to fall off, and, it may be added, without any prospect of increase. It must result in the Corporation of Liverpool having to go farther afield to find the water that will presently be required for the vast constituency which depend on their supply. It is a great pity to see them wasting their moral strength, as well as their money, on an endeavour to purchase the gas undertaking. The community supplied by the Corporation of Liverpool will, before long, be in want of water, and the first consideration of the Town Council ought to be to furnish all that will or may be required. The Verniew scheme promises to afford, for years to come, a supply sufficient for all needful purposes, and it is very much to be regretted that exceptional circumstances have stood in the way of the promotion of this scheme in the next session of Parliament.

The Local Board of Wimbledon have been again discussing the question of the water supply of their district. Their choice lies between taking what is ready to their hands—and that is, availing themselves of the supply of the Lambeth Water-Works Company—and the digging of an artesian well in the chalk, we forget how many miles away from the district. The Board now seem inclined to close with the Water Company, and save further disputes. It is acknowledged, on all hands, that the water supplied by the Thames Companies is being rapidly improved; and in none, perhaps, has this improvement been so great, within the past year, as in that of the Lambeth Company. We may therefore safely recommend the Wimbledon Local Board to take their supply from that Company, the outlay on which will not cost them anything.

It is of great benefit to a Company to have an experienced "bagman" at work. Perhaps there is not a better one extant at the present time than Sir H. Cole, C.B., who recently presided at a meeting of local surveyors at Manchester. Of course, he did not utter one word in reference to Scott's Sewage Company. His innocent object was to recommend Local Authorities to combine together, and have their sewage purified. Of course, Scott's is a system which should be adopted, *cela va sans dire*; but that was kept in the background. It is a great pity that Sir H. Cole does not take his well-earned leisure, and rest his overworked brain; for what he is now doing towards the purification of sewage appear to us to be next to valueless.

The inhabitants of Kingston-on-Thames are not well satisfied with the scheme selected by the Joint Drainage Board. They do not say it is good, and do not say it is bad; but they want more time to think over the matter. If they had years given to them to cogitate, Surrey men would still hesitate if there were a prospect of a penny rate to pay. It is a misfortune that the agricultural mind can never grasp the idea of something useful to be done at the expense of a little public money, and

the readiest means of obstruction is the interposing of delay in parliamentary proceedings. We earnestly hope that the Joint Board are sufficiently strong to prevent these obstructionists from standing in the way of the proposed reforms.

Communicated Article.

ELECTRIC LIGHT.
GAS: PAST, PRESENT, (PROBABLE) FUTURE.
By Mr. J. O. N. Rutter.

PART III.

In concluding my last communication, I said (Nov. 12), "Let us wait a while." During the interval nothing very special has occurred in furtherance of the practical adaptation of electricity to ordinary lighting purposes. There have been numerous experiments. Some of these have been described as satisfactory, others partially so, and a greater proportion as failures. There will be—there must be—more experiments, and more failures are to be expected. Whether expected or not, they are the constant attendants upon new inventions. In comparatively simple affairs the mistakes and mishaps are frequent; and it would be strange indeed if the complications involved in lighting by electricity should as yet go on smoothly.

Failures properly examined, and rightly used, do no harm. They cause delays, disappointments, and apparently useless expenditure of money; but they are not so damaging as they seem to be. Out of many failures patiently borne, and cautiously investigated, there comes eventually the reward so long sought after.

History repeats itself in small things as well as great. Often and often have discoverers and inventors failed to complete what they began. How many have been the instances in which men, eminently endowed with germs of thought, which they have scattered broadcast in hints, conjectures, opinions, and proposals, but have never had means or opportunities for reaping one sheaf from the golden harvest which has been gathered by others. It is not more strange than true that many originators in all departments have gone on for years plodding, planning, and contriving; and have made no approach towards success until all has passed over to other heads and hands. There is nothing surprising in this. It is among our every-day experiences. Toil and moil long continued, and on one subject, bring weariness that is understood only by those who have endured the pressure. It is easy work for lookers-on to pass judgment, and ask why this, that, and the other be not done. To listen to such persons, it might be supposed they knew everything, and, perhaps, a little more. But they do not; for they have never been troubled by swelling and throbbing of the temples, and a thud-thudding near the region of the heart.

What does this mean? What many of the ablest men in past times and our present times have had to bear. The greatest benefactors in these matters are commonly the greatest sufferers. They suffer not only by over-crowding of thoughts, sleeplessness, and brain-wearing; but there are the disappointments so inexplicable, which are like inversions of mental capability—a lacking of what others possess by a sort of intuition.

It is not unreasonable to believe, nor improbable to expect, that electricians, properly so called, will not be able, without assistance from without, to accomplish all they are working for. It is one thing to know how to produce a brilliant light, but more than that is required. The light has to be applied, adjusted, distributed, controlled for useful employment in various localities, so that it shall not overdo its part in one place or underdo it in another. It requires less science than it does practical common sense to judge if a light, electric or any other, harmonizes with the objects to be illuminated. This appears to be what is most needed in applying the several methods of electric lighting hitherto devised.

Experiments and experiments—these will be continued. There is as much need of them as ever. A practical adaptation of the electric light is yet in the future. There will be more attention given to details—the little things, without which the greater are unattainable. What has been done is instructive. It is significant of what has to be done; not an unnecessarily great quantity of light—not a nictating light of uncertain duration. When some of the talk about hundreds of candles illuminating power has ceased; when the continuance of the light at a uniform intensity for an unlimited (or limited) number of hours has been established; when the places to be occupied, and the duties performed by the light have been settled; then, and not till then, must it be said that the real work of lighting by electricity has commenced.

Whether the period be near or remote when lighting by electricity will have passed from experiment to practice, no one can determine. But we know it is on its way thither. There is the material, if it may be so designated, to work with—its supply is unlimited, its qualities unchangeable. In gathering and dispersing electricity for lighting or other purposes, however it be forced, or tortured, or compressed, it sustains no injury, it suffers no loss.

Thus much on electric light. Something has to be said about gas.

Black Rock, Dec. 26, 1878.

Suffocation of Four Persons by Gas at Cork.—During the night of Tuesday last an accident, by which four persons lost their lives, occurred in Cork. It appears that a disused gas-pipe in a shop on Kyrle's Quay had somehow been fractured, and the gas which escaped found its way into the sleeping apartment of a family named Butler, consisting of a man, his wife, and three children. The woman was restored to consciousness by the efforts of the police, but with the other four life was found to be extinct. An inquest on the bodies was opened the following day, and adjourned.

Correspondence.

[*We do not hold ourselves responsible for the opinions expressed by Correspondents.*]

THE ELECTRIC LIGHT.

Sir,—Mr. W. Scott, in his letter on the electric light, which appeared in your last number, refers to a statement made by a Mr. Hedges, in *The Times* of Oct. 12, to the effect that "when the electric light was tried along with a gas-jet on the Westminster clock-tower, the *electric light was not visible in a haze*, the gas-jet being the only light visible."

What I myself have observed entirely confirms this statement. On Tuesday evening last, I was walking over Westminster Bridge, from Westminster to Lambeth, at about five o'clock. It was foggy, and it was the first evening on which the Metropolitan Board of Works had discontinued lighting the gas-lamps between Westminster and Waterloo Bridges, leaving the electric light as the sole illuminator.

Looking along the Embankment wall from the Bridge, I could only see clearly three of the electric lamps, the clearness being, of course, in inverse proportion to the distance, but even the nearest of them looking like a red disc. By steadfastly gazing, I could now and then just perceive a faint glimmer of the fourth lamp.

Looking then to the Albert Embankment, on the other side of the river, I could see distinctly all the gas-lamps from Westminster Bridge to Lambeth Bridge, a distance more than double that of the fourth electric lamp which I could only discern at all from Westminster Bridge by fixing and straining the eye. The gas-jets, moreover, shone out bright and clear, whilst the electric lamps were, as I say, like red globes, or like the moon in a dense fog.

This struck me as rather remarkable, and I was glad to see my impression confirmed by the statement in Mr. Scott's letter.

Clapham, Dec. 27, 1878. Veritas.

THE USE OF GAS-ENGINES IN GAS-WORKS.

Sir,—Can any of your correspondents inform me as to the number of gas-works in England in which gas is used as a motive power?

The number of gas-works must be great where the power required does not exceed from 8 to 12 horse power, and there are gas-engines in the market to meet this requirement. Gas engineers will have a difficulty in extending the sale of these articles, unless they set the example of using them, especially as the first cost of gas is much less to them than to the general consumer.

Longport, Staffs., Dec. 26, 1878. Henry Peatt.

Miscellaneous News.

PUBLIC LIGHTING BY ELECTRICITY.

By Mr. George F. Deacon, M. Inst. C.E., Borough and Water Engineer of Liverpool.

[An Interim Report presented to the Liverpool Town Council, Dec. 4, 1878.]

Without a considerable knowledge of electrical science, the many methods of electric lighting cannot be understood in detail; but at a period when, owing to certain public trials in Paris, public attention is being directed to the subject in an altogether unprecedented manner, and when, as a natural consequence, a vast amount of inventive energy is being bestowed upon the improvement of the methods employed, it may not be out of place, before entering upon the immediate object of this report, to state the elementary, but broad principles which distinguish those methods

All apparatus for the production of the electric light consist essentially of three parts:—The battery, or machine in which chemical or mechanical energy is converted into electricity; the conducting wires, along which the electricity passes to the point at which the light is to be produced; and the lamp, in which the energy of the electric current is converted into light.

For the earlier electric lights, the electricity was generated by chemical action in galvanic batteries, and their uses were almost entirely confined to laboratory experiments and lectures. Recent improvements in the mode of converting mechanical energy into electricity have, perhaps, been the chief agents in effecting the introduction of the light for industrial and public purposes. Apparatus for this purpose all depend primarily upon the fact first indicated by Œrsted in 1820, and developed by Ampere, Weber, and Faraday, that if a magnet be moved in the neighbourhood of a wire capable of conducting electricity, a current of electricity is by that movement induced in the wire. If the wire is insulated and coiled round a piece of soft iron in the form of a horseshoe, so as to constitute what is known as an electro-magnet, and if, in front of the ends, technically called poles, of that electro-magnet, the poles of an ordinary permanent magnet are caused to revolve, the influence of the permanent magnet in producing a current in the wire is greatly increased. Upon this principle the first magneto-electric machine was constructed by Pixii in 1833.

Simple as this principle appears, the more efficient arrangements of such machines were only produced after 34 years, during which time the records of the Patent Office show how large an amount of attention the subject had received, in many cases from eminent scientific men.

The great reduction, effected by the best magneto-electric machines, in the cost of producing electric currents, opened a much wider field for the employment of electricity for illuminating purposes than the galvanic battery ever could have commanded; and for lighthouses and many other purposes, where intense and concentrated lights were required, the electric light was already coming into use, when, in 1867, Dr. Werner Siemens, Sir Charles Wheatstone, and Mr. S. A. Varley, independently, and almost simultaneously, conceived and described a principle, the application of which has mainly caused the recent rapid development of electric lighting for industrial purposes. The so-called permanent magnet of the old magneto-electric machine was never really permanent, and a considerable loss of useful effect resulted after continued working. But the magneto-electric principle, already adverted to as having been first discovered by Œrsted, did not necessarily involve the use of a permanent magnet; an electric current could also be produced by the movement of a simple piece of iron in front of the conducting wire or of the electro-magnet, though in this case the current was exceedingly feeble; but, by covering the piece of soft iron with another part of the same insulated wire which surrounded the electro-magnet, in such a manner as to form another electro-magnet, and by causing the poles of the second electro-magnet to revolve in front of the poles of the first, a result of the greatest importance ensued. The very feeble initial current produced in the coil of the fixed electro-magnet passing through the coils of the revolving electro-magnet, induced around it a magnetic field which immediately intensified the initial current

circulating round both magnets, and each electro-magnet, with its power thus increased, reacted on the other, until complete magnetic saturation was attained; and thus, by mutual action and reaction, the feeblest initial current may now be increased to almost any required strength, with an expenditure of energy, the cost of which is small in comparison with that required in the case of magneto-electric machines, and quite insignificant in comparison with that of galvanic batteries. Machines constructed on the last principle are known as dynamo-electric machines, and the most efficient are those of Dr. Siemens and M. Gramme.

With a few recent notable exceptions, the lamps in which the energy of the electric current is converted into light are of the class known as regulators. Such lamps consist essentially of two pencils of carbon arranged in the same vertical line, with their ends separated by a small space. The upper carbon is connected by a conducting wire with the positive pole, and the lower with the negative pole of the machine. The current having been once established, meets, in passing from the upper to the lower carbon, with a certain amount of resistance, by reason of the division between the two carbons, and at this point of increased resistance the energy of the electricity is converted into heat and light. The luminous ovoid space between the carbon points is known as the voltaic arc, and although, owing to the small size of this space, very little heat is radiated, or carried upwards by the air, the temperature of the voltaic arc is so high that the most refractory substances may be rapidly consumed by it. Into this little furnace are projected, by the electric current, minute particles of the upper carbon and of the foreign matter associated with it, and from the crater thus formed in the upper carbon and the surfaces of the incandescent atoms is emitted a light, the intensity of which is little inferior, area for area, to that of the sun. With the carbons separated as in their normal working condition, the voltaic arc cannot at first be established, and in order to establish it they must be caused momentarily to touch, or nearly to touch, each other. Moreover, there is a certain distance apart of the carbons at which the best light is produced, and as the carbons are constantly shortening by combustion—the upper one about twice as fast as the lower one—they must be constantly moving towards each other. Before ignition, therefore, the carbons must be touching, and when burning they must be separated by a certain space, and must consequently move towards each other at precisely the same rate at which they burn away. A mode of regulating the distance apart has been found in the fact that any increase of distance increases the resistance, and therefore diminishes the current, and, by causing the strength of the current to determine the distance apart of the carbons, through the agency of an electro-magnetic apparatus contained below the lamp, and actuated by the current, many inventors have produced electric lamps, or regulators, which have fulfilled, in a more or less perfect manner, the required condition. Regulators supplied with electricity by dynamo-electric machines, driven by steam or other motive power, have been extensively used within the last ten years for lighthouses, for naval and military signalling, for tidal and other engineering works, and in certain industrial establishments, and upon the efficiency of such combinations most of the statements laid before the public up to a recent date as to the relative cost of electric lighting and gas lighting have been based. Perfectly true though those statements have been, the inferences to which they have led have been most misleading.

It is true, for example, that the cost of light from ordinary regulators having nominal illuminating powers of from 6000 to 15,000 candles is, according to circumstances, only from one-fifth to one-half the cost of gas producing the same candle power; but in the case of the electric light a greatly increased candle power is indispensable to produce the same degree of illumination, as the following considerations will show.

The light from each regulator cannot be efficiently reduced below 1000 candles, and gives a much higher efficiency when increased to 10,000 or 15,000 candles. Regulators giving 6000 candles each are very commonly used. The most favourable place for the employment of such a regulator would be the centre of a circular space. If such a space were 500 feet in diameter, the light in the centre line of a circular carriage-way just within it would be greater than that in a Liverpool street illuminated in the ordinary way. To illuminate the whole area with gas rather better than the electric light would illuminate the centre of the supposed carriage-way, would necessitate the use of only about 125 Liverpool street-lamps of 16-candle power each. Thus with gas lights having an aggregate power of only 2000 candles, a better effect is produced than with the electric light having a power of 6000 candles, even in a case particularly well adapted to give the best result attainable from a concentrated light. It is obvious, therefore, that any comparison of cost based merely upon the relative candle power of electric and gas lights must be misleading, and yet upon this principle many of the published comparative statements have been based.*

From the above considerations, it is evident that if the illuminating power of each electric light could be greatly reduced without increasing the relative cost, the total expense of illumination by electricity would be much less than that of illumination by gas. It is natural, therefore, that the subject should have attracted the attention of many inventors, though, owing to certain dynamic obstacles, the eminent men who have made electricity a subject for mathematical research have not generally regarded the economical subdivision of the electric light as a promising matter for experimental investigation.

It appears, nevertheless, that as long ago as 1858, M. Jobert, of Brussels, a scientific man, according to M. Hippolyte Fontaine, not likely to be carried away by the enthusiasm of an inventor, communicated to the Academy of Sciences, on the 27th of February in that year, the following account of the complete success which M. de Changy had met with in dividing the electric light, by the substitution of platinum in the regulator for the carbons generally employed. The opening words of M. Jobert, almost literally translated, were as follows; and in reading them one is readily reminded of a somewhat similar and equally enthusiastic communication with respect to an American invention for subdividing the electric light by the use of the same metal, which appeared in the English papers a few months ago:—

I hasten to announce to the Academy the important discovery of the division of the electric current for lighting purposes, proceeding from one source by as many wires as may be desired, and producing any light, from that of a night-light to that of a lighthouse.

It is well known that the voltaic arc produces between two carbons a very intense, flickering, disagreeable, and costly light. M. de Changy, at once a chemist, natural philosopher, mechanician, and practical man, fully conversant with the latest discoveries and apparatus, has just solved the problem of dividing the electric light. I have come from his laboratory, where he has worked alone for six years, to give a short account of what I have seen there.

A battery of twelve Bunsen elements, improved by him, produced a constant luminous arc, without flickering or crepitation, between two carbons governed by the most perfect and simple regulator I have seen; further, there were twelve little miners lamps—moveable tripods—any of which might be lighted or extinguished without diminishing or increasing the remaining light. These lamps, enclosed in glass tubes hermetically sealed, are intended for lighting mines liable to fire-damp, as well as for street-lamps, which might all be lighted and extinguished throughout a town by simply opening or closing the circuit. The light is as white and pure as Gillard's gas, with which it has this one point in common—that it is produced by the incandescence of platinum. The gas-pipes will be replaced by simple wires, and no explosions, fires, or smells can be caused. All previous attempts to produce electric light by the incandescence of platinum have proved abortive, owing to the melting of the wires from the want of a dividing current-regulator, and this is the problem which M. de Changy has solved. He estimates the cost of the light at half that of gas.

In this manner M. Jobert continues to describe the lamp and the numerous uses to which it could be put. There is no reason to doubt the accuracy of his account of what he saw, but there is every reason to doubt the conclusions he drew, and the accuracy of M. de Changy's estimate of the cost. Very little more appears, however, to have been heard of M. de Changy's invention.

Passing over a few ingenious arrangements, which have never found their way beyond the laboratory, it appears Mr. Werdermann described in 1876 a principle which, in 1877, M. Jablochkoff applied for the partial subdivision of the electric light.

In this lamp, now universally known as the Jablochkoff candle, the carbon pencils, instead of being in the same vertical line—*i.e.*, one above the other—are side by side, and they are separated by an insulating material about an eighth of an inch thick. The electric current passes up one side and down the other, and, when once established, it is clear that, as the distance apart of the carbons is unchanged, no regulator is necessary to maintain that distance. In order, however, to allow the electric current to pass in the first instance, and thus to establish the light, the carbons cannot be brought together as in the regulator, and it is therefore necessary that each candle should be tipped with a piece of carbon or other conductor. It has already been mentioned that the positive carbon is consumed about twice as fast as the negative carbon, and as different rates of consumption are obviously inadmissible where the carbons are placed side by side, it is necessary to give a very rapid alternation to the direction of the current, by which means both carbons are equally consumed. As the carbons burn, the insulating material—sulphate of lime, in practice—fuses and volatilizes, leaving a space above it, across which the voltaic arc is formed. The resistance is probably less than in the case of a regulator, and, being subject to less variation, it is found that several lamps may be placed on a single line of wire, the same electric current passing through all.

The application of the Jablochkoff candle to the illumination of certain public thoroughfares, hotels, and other places in Paris, and the use of the Lontin system in the St. Lazare Railway Station, and in certain theatres, has given to those who have visited Paris this year an excellent opportunity of judging of the effect of the electric light.

The new thoroughfare known as the Avenue de l'Opéra, with the Place de l'Opéra at one extremity and the Place du Théâtre Français at the other is 1000 yards, and the width 32 yards at the narrowest part. It is illuminated from dusk to midnight by 64 electric candles, placed on columns about 16 feet above the pavement, and surrounded by globes of opal glass about 18 inches in diameter. The globes are so far opaque that the position of the electric light within cannot be distinguished, and they have very much the appearance of intensely brilliant moons, not too brilliant, however, to be looked at steadily with the naked eye. The effect is greatly enhanced by reflection from the white limestone of the new and handsome buildings on either side.

The light on the pavement in the centre of the Avenue, which is the least-illuminated portion, is apparently greater than that given on a very clear night by the moon when full and high above the horizon, while the buildings and most other objects are much more strongly illuminated. The colour of the light, moreover, is exceedingly like that of the moon, as the Engineer had an excellent opportunity of observing; but, unlike the light of the moon, the Jablochkoff candles are sufficiently distributed to prevent any shadows of importance. In the Place de l'Opéra and in the Place du Théâtre Français, where many thoroughfares meet, the illumination is still more brilliant. Looking up the Avenue from the Rue St. Honoré towards the Opera, more than half a mile distant, the effect is perfectly unique, and must be seen to be duly appreciated.

The Engineer is much indebted to the Engineers of the Municipality of Paris for information concerning the working and cost of the light. The engines and machines supplying electricity to the lamps of the Place du Théâtre Français are in the basement of an unfurnished house in the Avenue, those connected with the Avenue lamps are in the Rue d'Argenteuil, about 50 yards from the Avenue, and in the Rue Gaillon, about 10 yards from the Avenue; and those belonging to the lamps in the Place de l'Opéra are in a vault beneath the Opera House. The arrangement in all three cases is nearly the same. In the first, for example, there is a steam-engine of 18 or 20 horse power, driving two machines, one being the well-known Gramme machine, giving a constant direction-current, and the other being a machine more recently designed by M. Gramme for the purpose of alternating and increasing the current of the first machine, and thus rendering it suitable for the Jablochkoff candles. From the latter machine are laid four cables, each passing through and supplying electricity to three or four lamps, and then returning to the machine. Each cable consists of several strands of copper wire insulated with gutta-percha, and protected by earthenware drain-pipes laid beneath the footway. In the pedestal of a lamp the wire is electrically connected with a small piece of metal. Four other small pieces of metal, placed at about an inch from the first, are connected with four wires carried up the lamp-post, each communicating with one of the carbons of a Jablochkoff candle, four of which are fixed on each lamp, about two inches apart. The second carbons of the same candles are connected with a single wire passing in the same manner through two or three other lamps, and ultimately returning to the other pole of the machine. If the arrangement were left as thus described, no current could pass through any of the candles, because the wire from the machine terminates at the first piece mentioned, and has no metallic connection with the other four. On the first piece, however, there is pivoted a piece of metal, capable of being turned round with a key on to any of the surfaces of the other four pieces. Thus, any of the latter pieces may be brought into metallic contact with the former, and by this simple process the current may be established through any one of the candles. The little apparatus thus described is known as a commutator.

Each Jablochkoff candle burns nominally for an hour and a half; but as the accidental extinction of a single candle would, by interrupting the current, extinguish the other three on the same circuit, it appears to be usual to turn the commutator so as to direct the current to another candle after the last candle has burnt but little, if any, longer than an hour and twenty minutes, so that the four candles last from five hours and twenty minutes to five hours and a half. It is obvious that a larger number of candles may be fixed on each lamp if separate wires are carried up from the commutator.

The cost, for which the Engineer is indebted to M. Allard, Ingénieur-en-Chef des Ponts et Chaussées, is about 7·68d. per candle per hour, and each naked candle is equal, according to the Société Générale d'Electricité, who are proprietors of the patent, to about 50 Carcel burners, or 465 standard English candles. Photometric experiments, conducted by the Engineer upon similar lamps, supplied with electricity in a similar

* In the particular example adduced, much additional light might be obtained at the boundary of the circular space by the use of a properly-constructed reflector. But the conditions assumed are exceptionally favourable to the electric light, and, under ordinary circumstances, even with the best reflectors, the discrepancy would not be less than is thus shown.

manner, gave an average for the naked light of 453 standard candles when the electric candle was placed with its side to the photometer; when placed with its edge to the photometer the light was somewhat less. In this average the occasional very large diminutions of intensity, lasting for short periods, are not included.

In the course of continuous observations of twenty minutes duration, the light occasionally exceeded the 465 candles given by the makers, but within the same period it often fell below 394 candles, and occasionally, for a few seconds, very much below it. On another occasion, under precisely the same conditions, the electric candle was obviously burning unsteadily, and the variation in the illuminating power was much greater, and the mean much less. This is precisely what the Engineer was led to expect from observing the Jablochkoff candles in Paris. Here and there one was seen to be burning very unsteadily, and with a comparatively low illuminating power. The proportion of violet and red rays was almost constantly changing—an effect probably due to the vapour from the insulating material between the carbons; but, owing to the great number of lights, these fluctuations were not noticed in the Avenue, except when individual lamps were watched; though, on attempting to read by a Jablochkoff candle in a large room, the effect was very marked and unpleasant.* Taking all the circumstances into consideration, the Engineer is of opinion that the mean illuminating power, in a horizontal plane intersecting the voltaic arc, of the electric candles in the Avenue de l'Opéra is less than 453 standard English candles each. But it must not be forgotten that it is thought necessary to enclose the candles in opal globes, and, though there can be no doubt that this greatly adds to the beauty of the light, it seriously detracts from its available power.

Upon this point the Engineer has made careful photometric observations, which show that only 42 per cent. of the light from an electric candle, giving an illuminating power of 453 standard candles, is transmitted in a horizontal direction from the two flat sides of the candle through the globe, so that the light actually available from each lamp is less than 172 candles.

In considering what number of the 16-candle gas-burners employed for public lighting in Liverpool would give the same amount of light to a thoroughfare like the Avenue de l'Opéra (not including the two adjoining Places), it is necessary to calculate the amount of light along the centre line of the carriage-way, and so to arrange the gas-lights that at no points shall the light be less than is produced along that line by the Jablochkoff candles. Having regard to the fact that the intensity of light varies inversely as the square of the distance from the object illuminated, the comparison is readily made, and assuming the too favourable view that the electric light along the carriage-way is equivalent to the concentrated light of 172 candles at each lamp, it is found that to illuminate it equally well would involve the use of 165 Liverpool street gas-jets, in substitution for the 32 Jablochkoff electric lights, each jet having a power of 16 candles, reduced to 14·08 candles by the glass of the lantern.† The gas-lamps would be placed 2 feet from the kerbs, and 27 feet 6 inches apart. With this arrangement the footways would be more brilliantly illuminated than with the Jablochkoff candles, and the darkest parts of the carriage-way would be equally, if not better illuminated. The total candle power of the electric lights is taken at $172 \times 32 = 5504$ standard candles, while the total power of the gas would be only $14{\cdot}08 \times 165 = 2323$ candles, though its effect in lighting the Avenue would be as great, if not greater, showing the benefit of subdivision of the light when it can be effected without increased cost.

Including interest on the cost of the lamps, price paid for the gas and for lighting, repairs, and painting, each public lamp costs the Liverpool Corporation about 0·243d. per hour when in use. The comparison for equal illumination of the centre line of the carriage-way in each case would, therefore, be—

32 Jablochkoff candles, at 7·680d. per hour,	£1	0s.	6d.
165 Liverpool gas-jets, at 0·243d. „	0	3	4

But such an illumination as either of these methods provides is immensely greater than has ever before been thought desirable for permanent use. To illuminate the Avenue de l'Opéra to the same extent and at the same cost per unit of area as the best-lighted thoroughfares in Liverpool, would involve the use of only 47 gas-jets, at a cost, as before, of 0·243d. each per hour.

The total cost of lighting, according to the highest Liverpool standard, would therefore be 11·42d. per hour.

In terms of illuminating power, therefore, the electric light in question costs at least six times as much as illumination with Liverpool gas, while in terms of the area lighted, without reference to the amount of light, it costs 21 times as much.‡

But it would not be doing justice to the electric light to assume that the illumination of this great Parisian thoroughfare is a fair example of its utilitarian application. There can be little doubt that, in expending so large a sum during the Exhibition year, the Authorities were very properly actuated by other motives than the sufficient lighting of the last new Avenue. A scenic effect was sought, which must be eliminated from the calculations in order to render the results applicable to the ordinary illumination of public thoroughfares. The question thus involved will be further considered in the sequel.

Besides the Avenue de l'Opéra, the Place de l'Opéra, and the Place du Louvre the Arc de l'Etoile, and the *façade* of the Corps Législatif are public places brilliantly illuminated by the Jablochkoff candles. In the courtyard of the Hôtel du Louvre, in the drawing-room and dining-room of the Hôtel Continental, in the Magasins du Louvre (a large drapery establishment), and in the Hippodrome and Théâtre du Châtelet, besides many private works and other places, the light is in very successful operation. Most of these places the Engineer has visited and examined.

In a large number of public and private establishments in other countries the Jablochkoff candles are said to be successfully employed.

The system of M. Lontin appears, next to that just described, to have been most largely adopted in Paris, but it has not been employed for the lighting of public thoroughfares. The Engineer proposes, however, to refer to it and to several other systems, in order to give some idea of the prospects of improvement in public lighting by electricity.

The electric current is, in the Lontin system, constantly changing in direction, and, like the Jablochkoff system, requires at least two machines—one for generating and another for dividing the current. From the second Lontin machine many independent circuits may be taken. The lamps used are of the regulator kind; but the carbons are arranged in unusually great lengths, so that they are less frequently renewed than in the ordinary types.

In the St. Lazare Railway Station and in the Hippodrome the Engineer has examined this system. The effect is apparently all that can be desired, the light being steadier than any electric light which he has yet seen in practical use. In the railway station the lights have ground-glass lanterns, which obstruct a considerable portion of the light. The number of lamps worked by a single machine was twelve, and the number of separate circuits three; so that on each circuit there were four lamps, the greatest number in the Jablochkoff system being five. In the Hippodrome, this system is employed in conjunction with that of M. Jablochkoff. The Lontin lights are naked, and the rays are directed to the arena by funnel-shaped reflectors. Notwithstanding that the Jablochkoff candles are enclosed in the usual opal globes, the variation in their illuminating power was obviously greater than in the case of the Lontin regulators.

In the workshops of Messrs. Sautter, Lemmonier, and Co., makers of the Gramme machines, several regulators of the Serrin and analogous types are in nightly use. Wherever possible, the surfaces capable of reflecting light are whitewashed. The large workshops, measuring about 164 feet by 98 feet, are very well illuminated by three naked lights placed near the roof, the power of each light being given as from 1400 to 1500 candles. A smaller and comparatively low workshop, much broken up by the frames of heavy lens-grinding machines, is remarkably well illuminated with a single light. Being much nearer the ground than in other cases, the direct rays of this light are moderated by an opal glass lantern without a cover, and all rays passing upwards are reflected by two white boards placed over the lamp. In neither of the workshops are there any shadows of importance, and in the smaller one the Engineer particularly noticed that the shadows were not more pronounced than during the day. There is, however, considerable variation in the intensity of the light.

At Messrs. Sautter, Lemmonier, and Co.'s works, and when examining some other lights, the Engineer had the advantage of the company of the late Chairman of the Lighting Sub-Committee, Lieut.-Col. Hamilton.

General Considerations.

Having now referred particularly to the application of the electric light in Paris, it is desirable to consider the prospect of reducing the cost for public purposes more nearly to that of gas.

It may at once be stated that any attempt to reduce the electric lighting of any thoroughfare to the standard of public lighting adopted in Liverpool, or even to twice that standard, would involve an expenditure so greatly in excess of the cost of lighting by gas to the same standard, as to be quite out of the question. But admitting that in certain special cases it may be desirable to raise that standard considerably, it is important to consider how far the cost of lighting by electricity may be reduced.

Reverting to the Avenue de l'Opéra, it has been already shown that the opal globes obstructed 58 per cent. of the light. The globes are simply used for the sake of appearance, and to avoid the great intensity of the naked light; but the latter object may be attained by reducing only those rays which reach the eye when moderately near the lamp. By a modification of the globes, therefore, the efficiency of the Jablochkoff candles may be multiplied more than twice; and by the proper use of reflectors, by which the rays which would otherwise fall on buildings, and pass upwards, would be directed to the darker spaces between any two lights, the efficiency may be still further increased. There is also a serious loss due to the mode of subdivision adopted, the amount of which, however, is less certain, and a loss of probably 20 per cent. arises from the use of alternating currents. Unfortunately, the only lamps hitherto applied in practice, to which none of these objections apply, are the ordinary regulators, one only being placed on each circuit, and worked by dynamo-electric machines giving currents of constant direction. Here the great loss from concentrated light, already adverted to, comes into play; but even this disadvantage is so far smaller than the aggregate of the others, that the same degree of illumination could be attained in such a thoroughfare as the Avenue de l'Opéra by about seven concentrated lights, at less than half the present cost. The fact so often urged in Paris, "that it would not be so beautiful," must be freely admitted.*

M. Rapieff, a Russian gentleman, has invented a lamp, by the use of which a partial subdivision is effected, as in the case of the Jablochkoff and Lontin systems. The electro-magnetic apparatus by which the two carbons are maintained in their position is dispensed with, and a good voltaic arc is produced between four carbons, each pair of which meet like a V, and maintain their proper distance from the other pair by mutual pressure. Several of these lamps on one circuit are in successful operation at *The Times* office. To each lamp is attached an ingenious electro-magnetic arrangement, by which the extinction of any one of the lights may take place without affecting the others. Moreover, if in one lamp the voltaic arc is suddenly broken, it is instantly re-established, as in the ordinary regulator. In this lamp, as in other regulators, a current of constant direction may be used. M. Rapieff has also taken from the Jablochkoff candle the insulating material between the two carbons, and finds that a good voltaic arc may be maintained as before. Any such simplification of the present Jablochkoff candle must necessarily materially diminish the cost.

In all the partial modes of subdivision above described, the four, five, or, at the most, six lights, are placed on a single circuit in such a manner that the whole of the electricity, passing from one pole of the battery, traverses each lamp before it reaches the other pole. The resistance of the circuit is thereby greatly increased, and the condition of electricity known as tension, obtained by a particular arrangement of the dynamo-electric machine, is necessary in a considerable degree, in order to maintain the current. The limit to the number of lights must, on this account, if on no other, be very soon reached. Lights so arranged on a single circuit are said to be in *series*. But there is another mode of coupling known as *parallel circuit*. If part of a single wire circuit be cut out, and any number of wires, of any equal length, quality, and diameter, be substituted for it, any current passed through the circuit will divide itself equally among the separate wires; but, as its strength will also be divided in the same proportion, an ordinary electric light cannot be maintained on each of the separate wires. Mr. Werdermann has met this difficulty by the invention of a lamp in which high tension is not required. By making the negative carbon very much larger than the positive carbon, he finds that with dynamo-electric apparatus constructed for producing quantity and not tension, the two carbons may be allowed to touch, the positive carbon becoming incandescent. In this lamp it appears only to be necessary to secure a constant current of the right kind and a constant amount of pressure of the positive carbon against the negative carbon. As each lamp has its independent current its extinction can only brighten the others. This light has hitherto only been applied experimentally, but it is about to be employed for the illumination of the space in front of the London Royal Exchange and the Bank of England.

The Engineer has, however, examined the system in the works in London, where two naked lights, each stated to have an illuminating

* It is understood that an attempt has been made to alter the composition of the white light of the voltaic arc by the use of sulphate of baryta in conjunction with the sulphate of lime, and that the occasional red rays are due to this. In the East India Docks, where the Jablochkoff candles were tried last year, the insulating material was kaolin, or china-clay, which is said to have largely increased the proportion of green rays.

† The Liverpool street-lamps are regulated to give an illuminating power of 16 standard candles, with a consumption of 4 cubic feet of gas per hour, at a pressure of about 5-10ths of an inch of water, the cost of the gas being 3s. 6d. per 1000 cubic feet.

‡ The cost of lighting the Avenue de l'Opéra above referred to is nearly the same as the estimate published by the Company for the illumination of other places, if interest on capital expended and rent of premises be taken into consideration. [See *postscript*.]

* Since writing this report the Engineer finds that the subject of efficiency of concentrated lights, with proper reflectors, for public thoroughfares, is receiving the attention of Dr. Siemens, F.R.S., whose exertions in this direction may shortly be compared in practice with those of the many inventors who are improving the various methods of subdivision.

power of 320 candles, or ten naked lights of 40 candles each, are produced by 2-horse power. The candle power and the motive power are given as stated by Mr. Werdermann. The Engineer believes them to be correct, but he had no means of verifying them. In this, as in all systems of subdivision, there is considerable loss, as is shown by the fact that the power which will produce 640 candles in two lights will only produce 400 in ten lights.

As the production of light depends upon the resistance at the point to be illuminated being much higher than in any other part of the circuit, and as, by allowing the carbons to touch, the former resistance is much reduced, the remaining resistance must be kept down by increasing the size of the conducting wires, and this is an element of increased cost.

It remains to be seen whether or not Mr. Werdermann will succeed in making the cost of his system cheaper than the systems of division in series; but it is certain that he has produced ten perfectly steady lights of only 40-candle power each from a small electro-plating machine—a result which appears to be a most important advance in the practice of electric lighting.

Some time past the English papers contained accounts of an invention by Mr. Edison, of the United States, for subdividing the electric light, but the Engineer has been unable to obtain authentic particulars of the improvements in question.

The Engineer has referred almost exclusively to the use of the electric light for exterior illumination. For the lighting of public halls, however, it has peculiar advantages. The light, if properly diffused and sufficiently brilliant, is very like daylight, and the vitiation of the air is scarcely appreciable.

Conclusions.

As indicated in the foregoing report, the Engineer is of opinion—

1. That the cost of the only system of public lighting by electricity at present in use is 6 times the cost of Liverpool gas producing the same degree of illumination, and 21 times the cost of the Liverpool gas which would, under ordinary circumstances, be consumed in the illumination of the same area.

2. That the great discrepancy in the cost of public electric lighting in Paris, and of public gas lighting in Liverpool, is due in a high degree to the fact that the agreeable effect produced by a succession of large semi-opaque globes, equally illuminated, has been regarded as the first consideration.

3. That, apart altogether from the palpable loss produced by the opal globes, there are further losses of a very serious kind, which are not common to some other existing methods.

4. That it is obvious, from dynamical considerations, that the electric light, when subdivided, will always give a less candle power for the same expenditure of mechanical energy than when concentrated; but with the materials at present available, it is impossible to say whether that loss will always be so great as to leave the concentrated light, treated in the best manner, more economical than the divided light for public illumination.

5. That the spaces north, east, and west of St. George's Hall, Liverpool, are well adapted for illumination by electricity, and as a new engine has lately been erected in the basement of the hall for pumping to the Steble Fountain, the Engineer recommends that such dynamo-electric machines, to be driven by that engine, be obtained as will enable the Corporation to make a fair trial of various systems for the illumination of the spaces in question. Estimates have been obtained from the various makers for the supply of the necessary apparatus.

In such comparative trials, the practical effect of the lights may be estimated by the public, but the power of the engine should be measured by a dynamometer, and the power of the lights by a photometer. The Engineer will then be enabled to report exactly as to the relative cost of gas lighting and of the various systems of electric lighting, when applied in the most economical manner in Liverpool. He has little doubt that a very considerable reduction upon the cost in Paris may be effected.

Postscript.

Since the printed proofs of this report were returned for correction, the Engineer has received a long and most valuable letter from M. Allard, Ingénieur-en-Chef des Ponts et Chaussées, in which the results of the recent experiments undertaken by him for the Municipality of Paris are detailed.

M. Allard found, by photometric trials in the horizontal plain intersecting the Jablochkoff candle, enclosed by an opal globe, an illuminating power of 18 Carcel burners, equivalent to 167·4 standard candles. As the Liverpool measurement was 172 candles, the agreement is singularly close. It is stated, however, that the globe tested by M. Allard only absorbed 40 per cent. of the light, so that the naked light in the French experiment gave only 30 Carcel burners, equivalent to 279 standard English candles. The Engineer's impression, therefore, that he had over, rather than under stated the power of the electric candles is confirmed.

M. Allard lays much stress upon the fact that from the Jablochkoff candles more light is emitted above the horizontal plane than below it, and he has made photometric experiments in the Avenue de l'Opéra to determine the effect of this peculiarity. While conducting these trials, the rays from other lights and the reflections from buildings were carefully screened off, and the result showed, for one of the Jablochkoff candles *in situ*, a mean illuminating power, at the level of the pavement, of only 12·1 Carcel burners, equivalent to 112·5 standard English candles; but in considering the effect of this determination, it must be borne in mind that the light a few feet higher is more intense.

The contract entered into by the Société Générale d'Electricité for lighting the Avenue de l'Opéra and adjacent Places having expired, the contractors offered to renew it at the rate of 5·76d. per candle per hour; this gave for the 62 candles £1 9s. 9d. per hour.

The same space lighted by gas after midnight, according to the Paris standard of public illumination, which is much higher than that of Liverpool, requires 344 gas-jets of 10·23 candles, costing 0·2016d. each, or 5s. 9½d. in all.

Thus the electric lights, when measured at the level of the pavement, gave 62 × 112·5 = 6975-candle power, and cost £1 9s. 9d. per hour. The gas gave 334 × 10·23 = 3519-candle power, and cost 5s. 9½d. per hour; so that for each unit of light measured in candle power, the electric light costs 2·6 times as much as the gas. But in this determination the diminution of light due to the wider spacing of the lamps is not taken into account; and the Municipal Council of Paris decided, on the 30th of October last, to reject the contractors terms of 5·76d. per Jablochkoff candle, but agreed to continue the present arrangements till Jan. 15, 1879, if the contractors were satisfied with a remuneration equal to the price paid for the gas, without reference to the greater illuminating power of the electric light—that is to say, 5s. 9d. instead of the £1 9s. 9d. asked for. Rather than remove the apparatus, the contractors have accepted these conditions.

Sale of Gas Shares at Deal.—On the 17th inst., ten A shares of £10 each in the Deal and Walmer Gas Company were sold by auction for £15 10s. per share; and ten C shares, £5 paid, realized £6 15s. each.

THE PROPOSED PURCHASE OF THE EXETER GAS-WORKS BY THE CORPORATION.

A Meeting of the Exeter Town Council was held on Saturday, the 21st inst.—the Mayor (Mr. W. H. Ellis) presiding—when the Parliamentary Committee presented a very lengthy report, extending to 46 octavo pages, on the proposed purchase of the gas-works. It was the result of a resolution of the Council on the 27th of November—"That the Parliamentary Committee be requested to prepare a full statement of the question of the purchase of the works and undertaking of the Exeter Gas Company, and the reasons which have influenced the Council in the course they have adopted, with a view to its general publication among the citizens; and that power be given the Committee to employ the services of a professional accountant in investigating the accounts of the Gas Company, and to embody his report in the statement prepared by them."

The Parliamentary Committee reported that they had employed Messrs. Quilter, Ball, and Co., Accountants, of London, to examine the Gas Company's accounts; and Mr. Arthur Silverthorne, of Victoria Street, Westminster, to report on the outlay which would probably be needed to put the present works in an efficient state of repair, and, further, on the probable cost of removing the manufacturing department to the site which has been scheduled in the *London Gazette* notice. The Committee then trace the history of the negotiations for the purchase from the beginning. There has, they observe, been for many years a growing feeling that the water and light supply of towns ought to be in the hands of the local authorities. This feeling has been shared in Exeter; and so long ago as the autumn of 1875, negotiations with the Gas Company were opened. On Sept. 22 of that year it was resolved that the Company should be asked if they were willing to treat for a transfer of their works, and on what terms. The Company replied that they were willing to consider any definite proposal, and on the 30th of November the Council agreed to a resolution offering to purchase the business as a going concern, on the terms of guaranteeing to the holders of shares and debentures the same dividends and interests as they had been receiving during the three previous years; as to the share capital in perpetuity, and as to the debenture debt until the expiration of the terms for which the debentures had been granted—such payments to be charged upon the rates. The Company, however, were unwilling to accept these terms, because, during the three years mentioned they had suffered from the effect of the coal famine, and the holders of the 10 per cent. stock had been receiving only 8 per cent. The negotiations were, therefore, broken off. Owing to the great complaints as to the quality of the gas, and the manner in which the city was being treated, the negotiations for a purchase were renewed in the spring of 1876. The Council believed that the desired improvements were more likely to be effected by a public responsible body than by a private company; and by Mr. G. W. Stevenson, the eminent gas engineer, they were strongly advised that the works ought to be in their hands, and that, as the Company's capital was exhausted, the present afforded a favourable opportunity for their acquisition. A correspondence ensued, and on May 23, 1877, the Council agreed to treat with the Company for the purchase, on the following basis:—"That the Shareholders should be paid a guaranteed dividend of 10 per cent. on the original capital of £40,000, in addition to the interest on the preference capital and debentures, the latter to be paid off in full by the Council as they may come to maturity, or renewed on such terms as may be mutually agreed on." The Council at this time were under statutory notice, by certain ratepayers, to prosecute the Company for creating a nuisance; but those ratepayers, learning that these negotiations had been set on foot, notified that they were willing to withdraw it, if the Council would assure them that the negotiations should not be so prolonged as to defeat the prosecution if ultimately taken, and would also undertake, in the event of a purchase, to carry out the improvements necessary to remove the nuisance. But the negotiations on this occasion also fell through, the Council having on June 27, 1877, resolved that in view of other inventions for the supply of light, it was unadvisable to continue any negotiations for the purchase of the property of the Gas Company. Nothing further was done until the spring of the present year, when the Company applied to Parliament for a Bill to authorize the raising of additional capital and the extension of their works, and thereupon the Council presented a petition to Parliament, which they prosecuted in both Houses. After their return from London, the Committee presented a full report of their proceedings, in which they urged the Council to endeavour to acquire the undertaking of the Company, and showed how the income was to be derived for paying the charges which the purchase would involve. The Council thereupon determined to make the Company an offer to purchase, as follows:—1. To guarantee to the Shareholders the payment of the maximum dividends authorized by their Act of 1865, redeemable at 25 years purchase. 2. The debenture debt to be taken over by the Corporation. 3. The present reserve-fund to belong to the Shareholders. 4. The purchase to take effect as from Midsummer-day, 1878. 5. All the debts and liabilities (other than bond and mortgage debts, and except debts incurred for the construction of new works) incurred before Midsummer, 1878, to be paid by the Company. 6. The Company to proceed with their present Act, which shall include proper clauses for giving effect to these terms, if accepted. A long negotiation followed, with no result. At length the Bill was committed in the Commons, and the Parliamentary Committee once more met the Gas Directors in London. Still strongly advised by their Engineer to purchase the undertaking, they entered into a provisional agreement, which the Council adopted on July 10; and, at the next meeting, the Council, by the statutory majority, resolved to promote a Bill to carry that agreement into effect. The Committee then proceed to set forth the reasons which have influenced them in their course of action. These reasons were—1. The Council resolution of Sept. 22, 1875, re-affirmed in March of the present year. 2. The reasonableness of the terms upon which the works were to be acquired—viz., a guarantee of the maximum dividends upon the authorized capital and debenture debt, in addition to the very small cash payment of £6850. The Committee were advised that it was unprecedented for such a Company to have so small a proportion of its capital entitled to the maximum dividend of 10 per cent.; while the Exeter Company had no capital at the rate so common of 7½, and there was some as low as 4. 3. The probability that the quality of the gas will be much improved in the hands of the Corporation, and that considerable profit may be realized in aid of the rates, especially as a large increase may be relied upon from the sale of ammoniacal liquor, and as there is room for large saving on the leakage account. The Committee report that they were advised that in well-arranged and well-managed gas-works the annual profits may be taken at 40 per cent. on the revenue, and as the revenue of the Exeter Gas Company for the year ended June 30, 1877 (upon which the negotiations are based), amounted to £29,674 5s. 4d., and is steadily increasing, there can be no doubt that when the works are put in thorough repair (whereby a better article will be manufactured, and a saving effected on the leakage), the works at Exeter, like gas-works at other places, will show the same percentage of profit, and here, as elsewhere, not only add nothing to the burdens of the city, but contribute very materially to their reduction. The question of the electric light was, they say, referred to by the Committee, in their report presented on July 10. They notice it now merely to

point out that there does not appear to be any probability of the general employment of electricity for domestic use; while, as regards the lighting of the public streets, it may be observed that it appears, from the evidence given on behalf of the Company before the Committee of the House of Lords, that at the present price at which they are bound to supply the gas required for the public lamps, no profit whatever is derived by the Company from this source, and, consequently, no loss would ensue were some other method adopted for lighting the streets.

Messrs. Quilter, Ball, and Co. reported that they had examined the accounts of the Company for the year ending June 30, 1877, and they append to their report five statements—a general balance-sheet, a profit and loss account for 1877, and revenue accounts for 1876, 1877, and 1878. The balance-sheet shows that on June 30, 1877, the capital was—

Original shares	£40,000 0 0
Four per cent. preference shares	10,000 0 0
Five " " "	20,000 0 0
Mortgages	5,900 0 0
Balance	774 5 8
Total	£76,674 5 8

The contingency-fund on the same date amounted to £2811, and the reserve-fund to £3246, the latter having been increased during the year by £113. The profit and loss account showed the profit in 1877 to have been £6690 19s. 6d., against £6075 12s. 6d. in 1876. The revenue account for 1877, prepared by Mr. Alfred Lass, showed that the manufacture of gas—including £13,169 14s. 10d. for coal, and £3761 for repair, maintenance, apparatus, and labour—cost £19,648 18s. 11d.; distribution of gas, £1047 17s. 8d.; lighting and repairing public lamps, £484 12s. 8d.; rents, rates, and taxes, £742 5s. 4d.; management—including £200 to Directors—£851; superannuation account to late Secretary, £250; "expenses attending agitation," £164 18s.; other small items brought up the total expenditure to £23,252 15s. 5d. On the other side, the receipts were—By sale of gas, £22,899 12s. 8d.; rental of meters, £573 15s. 4d.; coke, £4497; tar, £1459; ammoniacal liquor, £155; and other items brought up the total receipts to £29,595 5s. 3d.—leaving a balance of £6342 9s. 10d. to be carried to profit and loss account. The revenue accounts for 1876, 1877, and 1878 divide the expenditure under two heads. The expenditure for coal, salaries, wages, rates and taxes, lime and oxide, mains and services, public lamps, repairing meters, incidental expenses, and bad debts, are regarded as the items that should ordinarily be charged against revenue, in ascertaining the annual profits of the concern; whilst repairs, new mains, new meters, new retorts, &c., are placed in another classification. In 1876 the receipts were £27,791 10s. 8d. The cost of manufacture and supply was £19,272 16s. 2d., and the repairs £2656 10s. 5d.—leaving £5826 4s. 1d. available for dividend. In 1877 the receipts were £29,674 5s. 4d. Manufacture and supply cost £18,887 10s. 7d.; repairs, £4085 3s. 10d.—leaving £6711 10s. 11d. for dividend. For the year ending June, 1878, the receipts were £30,431. Manufacture and supply cost £20,500 1s. 1d.; repairs, £4144 6s. 5d.; leaving £5786 18s. 11d. for dividend. The detailed receipts of three years were—

	1876.	1877.	1878.
Gas and meter rents	£21,415	£23,473	£24,756
Coke	4,749	4,537	3,843
Tar and ammoniacal liquor	1,584	1,634	1,777
Other items	42	28	53
Total.	£27,791	£29,674	£30,431

They then detail various items in the accounts of 1877. They mention that the contract price of £155 a year for ammoniacal liquor is far below the sum which might be derived from that source, and with the termination of the present contract, improved revenue would be obtained from this source. Guided by practical views as to the charges which should properly have been made against the income of the year, they prepared a statement under which, according to their classification, the balance of ordinary receipts over ordinary expenditure was £10,796 14s. 9d., from which the Company actually deducted £4085 3s. 10d. for repairs, renewals, and extensions, reducing the net revenue of the year to £6711 10s. 11d., which sum was sufficient to provide for interest and dividends, leaving £615 to be added to the balance of undivided profit. They suggest that the Engineer employed by the Corporation should determine what figure would, in his opinion, represent the total of interest at, say, 4 per cent., on the cost of placing the works, gasholders, and principal mains, as they stood in 1877, in a state of efficiency; the annual sum which would thereafter suffice to provide for repairs, renewals, and other expenses coming under the heads which they had excepted from the account, and which make up the total of £4085 3s. 10d. above referred to. This figure (whether it was greater or less than £4085 3s. 10d.), being deducted from £10,796 14s. 9d., would give a true idea of the annual profit derivable from the capital which in 1876-77 was invested in the Company's business, so long as the sale of gas on the one hand, and the cost of production on the other, remain as they were in 1876-77. They next proceed to comment on several items in the balance-sheet which they think deserve attention. The capital raised appears, they say, to consist of £40,000 Ordinary Stock, and £10,000 Four per Cent. Preferential Stock, representing the capital outlay down to June, 1865; £20,000 raised by the issue of 800 Five per Cent. Second Preference Shares of £25 each, under the Act of 1865; £3000 Mortgage Debentures, bearing interest at 4½ per cent.; £2900 ditto at 4¾ per cent., making a total of £75,900. The capital expended in 1876-77 was £2536 8s. 5d. for a steam-jet exhauster, boiler, retorts, mains, and tar-tank, raising the total capital expended to £76,674 5s. 8d.; so that on the 30th of June, 1877, the expenditure on the capital account exceeded the receipts by £774 5s. 8d. The items included in the £2536 were, in addition to the capital expenditure, charged against the revenue. The reserve-fund was created out of £5540 8s. 2d. invested in Consols prior to the Act of 1865, and it was added to by £1312 4s. 8d. profit, after paying dividends, in 1871 and 1872, and by premiums on the sale of shares and interest received from the Consols. The fund was drawn upon in 1865-66 to the amount of £4597 4s. 8d. for parliamentary expenses, and in 1873-74-75 to the amount of £2484 7s. 6d., required to make up dividends. There was a loss on the sale of Consols, of £151 9s. 3d. At the end of 1876 the amount to the credit of the fund was £3133 0s. 10d., and that was increased during the year to £3246 14s. 6d. The contingency-fund was the residue of £3550 10s. 7d. undivided profit in hand when the Act of 1865 came into operation, and from it have been deducted sums for repairing the gasholder, station-meter, &c. The gas-rents and their mode of collection are next explained, and it is pointed out that the bad debts of the year amounted to only £23 5s. 1d., and, therefore, the customary reserve of £100 for bad debts seemed to be ample. Concerning the gas unaccounted for, it appeared, on an estimate, based on the quantity of gas made from every ton of coal carbonized, that the total make of gas in the year was 144,751,500 cubic feet, and, allowing 15,596,000 feet to have been consumed by the 853 public lamps, there was, after reckoning the sales to private consumers, 29,525,500 feet unaccounted for, being over 20 per cent. of the gas made. Improved arrangements might lead—and they understood were leading—to a considerable abatement of this loss. They finally make an examination of letters published by the Secretary, by the Town Clerk, and by Alderman Thomas. Taking the Town Clerk's figures of the cost of the concern at £177,850, that, redeemable in fifty years, would involve an annual cost of £8280. They, however, were not prepared to say whether the Town Clerk was right in estimating that the cost of production, including maintenance and renewals, amounted to £21,114 18s. 6d., and no more, but he was quite right in stating that the receipts for the year ending June 30 last had increased. They could not offer an opinion as to the net revenue available to meet the charges, until competent authority had stated what sum was sufficient to provide for maintenance and renewal.

Mr. Arthur Silverthorne reported as to the outlay that would be necessary to render the works thoroughly efficient, and also on the probable cost of removing the manufacturing part of the plant to a new site 2¾ miles from the present works. With reference to the supply of gas, he said the quantity sold in the year ending June 30, 1878, was 121,579,000 cubic feet; the make was stated to have been 151,762,000 cubic feet; and this established a leakage of very nearly 20 per cent. The rate of increase in the gas sold is at present 5·61 per cent. per annum. This rate of increase is most satisfactory, but the leakage denotes a state of things for which an inspection of the works and plant in a measure accounts. The works are, in many instances, worn out and very inadequate, excepting those parts which have been lately renewed, and the distributory plant is too small, and requires enlarging to a considerable extent. The services, he believes, will be found to be generally in a bad state, and a large proportion of the meters require to be renewed. To these causes must certainly be attributed the large extent of leakage. One of the holders, No. 3, is very leaky, and he thinks he is justified in asserting that while 3 per cent. of the gas is lost on the works, the remaining 7 per cent. in excess of a normal leakage is at present sacrificed in the distributory plant. Some of the services have been relaid in pitch troughs by Mr. W. A. Padfield, a course in which Mr. Silverthorne entirely concurs; and no doubt to this cause must be attributed *the decrease in leakage* as it now stands. (In 1875 the leakage was actually 28 per cent.) In fact, such as the works are, he understands they have been in a much worse condition, and during his visit they were certainly being conducted very skilfully, and, in his opinion, very judiciously, under trying circumstances, by Mr. Sidney E. Stevenson, for the present requirements of the city are fully exhausted, and but two benches were idle on the occasion of his visit, which was not even the shortest day of mid-winter. Under these circumstances, the proposal to re-model the works is urgently called for, and he is of opinion that the renewal scheme, if carried out, could not conveniently be postponed any longer. The cost (approximately) of this renewal he estimated—

New buildings	£8,150
New plant	16,200
Renewal of mains and relaying of services	10,000
Renewal of meters	5,000
Total	£39,350

He was quite satisfied that no adequate reduction of the leakage from its present extent could be effected without considerable alteration in the mains as at present laid, which would involve an expenditure of not less than £10,000. The meters he understood to be in many cases worn out, and were probably an important factor in the matter of leakage. He visited the site proposed for the new manufacturing works, and considered it excellent, provided it was not liable to be flooded. He estimated the cost of the removal of the works at £81,633. He estimated that in 1880 the amount of gas consumed in Exeter—supposing the demand to increase at the rate of 5·61 per annum—would be 135,577,094 cubic feet. This at 4s. per 1000 would bring in £27,115, to which he adds £570 for meter-rents, making the total income £27,685. The present works having been made efficient, he assumes that the unaccounted-for gas will be but 10 per cent. On the expenditure side he puts down coal at £12,080; but as against this he sets the value of coke, at 15s. per ton, at £5298; tar, £1213; ammoniacal liquor, £1750. These three items make up £8262, and leave as the net cost of the raw material £3818. Working expenses and maintenance are put down at the sum of £8186, leaving the net cost of manufacture at £12,004. The payment of 10 per cent. on the original share capital, 5 per cent. on £20,000 preference stock, and 4 per cent. on £10,000, involves another £5400; to this he adds £305 as interest on the debenture debt, £250 annuity to Mr. Williams, and £990 for interest at 4 per cent. on the capital expended—in anticipation—to June, 1878. This makes the total annual cost of the present concern, £18,949. If the manufactory is removed to Exminster, the annual cost would be £23,327. This sum would be produced by the sale of 135,577,094 feet of gas at 3s. 5½d. per 1000, and meter-rents would give a surplus over and above this. Supposing the manufactory were retained at the Basin, the annual cost would be £21,214. This sum would be produced by the sale of the quantity of gas above named at 3s. 1½d. per 1000. He considers that, under the scheme for remodelling the present works, the purchase presents a very attractive aspect. By the purification of the gas by the oxide of iron process now in operation at the works, he could see no prospect of a renewal of the nuisance which has so long caused annoyance to the inhabitants. This was due entirely to the fact of something like 60 tons of lime being used in a month; while the present quantity, in mid-winter, does not exceed 10 tons, and this is only used to extract the carbonic acid.

Alderman Thomas moved the adoption of the reports. In doing so he went into a comparison of the figures submitted to the citizens by Mr. Ralph Sanders, the leader of the opposition, with those published on behalf of the Town Council, the latter of which he showed were quite confirmed by the reports of the Accountants and Mr. Silverthorne. The comparison showed that Mr. Sanders had estimated the annual cost of the gas-works to the ratepayers (including redemption-fund) at £17,680, against £10,129 the estimate of the Council. Mr. Sanders's figures included a sum of £5000 a year for redemption of the purchase-money, which at the meeting of ratepayers he admitted to have been an error. He (Alderman Thomas) contended it was only fair that the comparison should stand upon the figures originally published by Mr. Sanders, because upon those figures the citizens had unanimously voted against the purchase. Then, again, in estimating the income, Mr. Sanders produced a total of £8500, whereas the figures for the Council showed an estimated income of £11,409. Thus Mr. Sanders had over-estimated the annual cost by £7000, and under-estimated the income by £3000, making a difference which would not only account for the rate of a shilling in the pound, which he said the purchase would entail, but leaving a balance of 3d. in the pound, or more, in aid of the rates. Making every allowance for possible excess on the side of the Council, it was expected that the works would yield a profit to the ratepayers of £6000 a year. With regard to the electric light, he did not believe it would be adaptable to domestic purposes for many years, and if it did become general for street illumination, that it would make no alteration in the estimates, inasmuch as the Gas Company now supplied gas for the street-lamps at cost price. In concluding a long and exhaustive speech, he said that whether the citizens at the coming poll ratified the purchase or not, he should always feel that the Council had performed their duty to the city in this matter, having done all in their power to remove a nuisance of long standing, and to reduce the rates of the city to a point that would bear comparison with any other city.

Mr. S. Jones seconded the motion.

Mr. F. Thomas supported the motion, remarking that, although he had taken the side of the opposition hitherto, he was now convinced that the Council would not be doing wrong in buying the works.

Mr. T. Andrew, as an accountant of some experience, was convinced, by a careful perusal of the figures contained in the report and appendix, that the Council would do wisely to buy the works.

Alderman Norrington said the question seemed now to be narrowed to a matter of opinion as to what the future of the electric light would be. Of course, those who thought electricity would entirely supersede gas would object to the purchase on any consideration; but he was not one of those persons, and believing that gas would always be wanted, and that it was for the public advantage that the supply should be in the hands of the responsible local authorities, he supported the motion.

Mr. Jones asked whether or not the Council, supposing the electric light became successful, would have the monopoly of the supply of it.

The Mayor said if they purchased the works, he took it for granted that they would.

Alderman Buckingham remarked that the Council had inserted in their Bill a clause which would give them the power of using the electric light if necessary.

Mr. Wilkinson regarded the reports as completely satisfactory, and thought the cost of producing the electric light would "kill" it, so that for a generation or two it would never be so applied as to do away with the usefulness of gas. He had tried as long as he could to get the terms of the purchase lessened; but, looking at the small amount of capital of the Company which carried a high dividend, he had come to the conclusion that it was desirable to purchase the works, and the reports presented showed the purchase would largely tend to the advantage of the city.

Alderman Thomas having replied,

The motion for the adoption of the report was put and carried unanimously.

A vote of thanks to the Parliamentary Committee, for the ability, trouble, and efficiency with which they had worked in connection with this matter, was carried by acclamation, and the Council adjourned.

Last Friday, a meeting of owners and ratepayers opposed to the purchase of the works—convened by the Hon. Secretary of the Ratepayers Committee formed at a previous meeting—was held, and was very indifferently attended, only about 50 persons being present at the commencement of the proceedings. The two resolutions proposed, and which were unanimously adopted, were—"That this meeting having considered the several statements published in reference to the proposed purchase of the gas-works by the Council, is of opinion that the purchase is undesirable on account of the very defective and deficient condition of the works, and the enormous price proposed to be paid for it;" and "That this meeting, considering that the proposed purchase will materially add to the already excessive taxation of this city, strongly urges the owners and ratepayers to vote against the purchase."

CHRISTMAS ADDRESS AT THE YORK GAS-WORKS.

In accordance with his usual custom, Mr. C. Sellers, the Secretary of the York United Gaslight Company, delivered an Address to the men employed at the works, on Saturday, the 21st inst.

He said: Fellow-workmen, my habit of wishing you a Merry Christmas and a Happy New Year has so grown upon me that I feel it is now a duty. Indeed, if I were not to do it, I confess to you that I should not feel comfortable. I am decidedly of opinion that it is a good thing for employers and employed to at least once a year shake hands, and exchange kindly and sociable greetings. Difference in position always has been, and probably will be to the end of time, but that is a mere conventional difference, which should make no alteration in the real relationship of one man to another. All men who are honest, truthful, and manly in their conduct can look heaven in the face, and claim the right of feeling that "one touch of nature makes the whole world kin." I, therefore, now want to shake hands with you, and to wish you all health and happiness in the new year that is upon us, and not only do I wish you health and happiness individually, but I wish the same blessing to your wives and families; and to those of you who, like myself, are not blessed with wives and families, I wish the same blessings to your sweethearts, with this proviso, that in the rejoicings of Christmas, which we all more or less indulge in, you remember what I have often urged upon you before, that you do not seek your rejoicings in public-houses, but at your own firesides, for, to my mind, there is nothing more selfish, and more unmanly, than that an individual should take his full swing of enjoyment, while his wife and children are half starving at home.

And now one word upon the past year. It has been one of great depression in trade and slackness in work; but we, as gasmen, have had nothing to complain of. On the contrary, we have been peculiarly busy, and our wages have not suffered. And to show that gas-making is not an unhealthy occupation, I do not think that we have had a single death in our ranks. And I am happy to say that this applies to our Directors. We have one Director, Mr. Henry Sotheran, who, from his age and long connection with the Company, is regarded as the father of the Board, and I feel sure you will all join with me in wishing that it may be many a long year before the Board want another father.

With regard to the electric light, which during the past year has threatened to snuff us out, I can assure you we have nothing to fear, for I am decidedly of opinion that, as a competitor with gas, the electric light will turn out to be less than the competition of a common dip candle.

I have said that during the past year we have all been fully occupied, and that we have earned good wages, and therefore I would ask you to remember those of your acquaintances who have not been so fortunate. Give them a trifling help, so that they may know that gasmen have hearts as well as hands.

Carlyle, one of the greatest thinkers of the present age, has said that there is not a more noble being on the face of the earth than an honest faithful workman; and therefore, by contrast, there is not a more cowardly and meaner specimen of humanity than a man who is unfaithful, and shrinks from doing his duty. It is true we have many annoyances, and sometimes unreasonable expectations on the part of the public; but I am quite sure, if we all do our best to win public confidence, we shall succeed, as I flatter myself we have hitherto done.

Gas Explosions in Scotland.—Two alarming gas explosions in Scotland were reported last Thursday—one in Johnstone, where a three-storey house was shattered, and a little girl seriously injured; the other in Glasgow, also doing considerable damage to a shop, and severely burning the owner.

New Sewage Farm at Mitcham.—On Monday, the 23rd inst., Mr. J. Spofford, the Chairman of the Croydon Rural Sanitary Authority, laid the foundation-stone of some new sewerage works at Bygrove Mead, Mitcham. The works are carried out from the plans of Mr. Baldwin Latham, C.E., and are expected to cost about £50,000. The farm will receive the sewage of the parishes of Wallington, Woadmansterne, Beddington, Mitcham, Merton, and Morden.

COMPLETION OF EXTENSIONS AT THE LLANDUDNO GAS-WORKS.

On Tuesday, the 17th inst., the Llandudno Improvement Commissioners paid a visit to the gas-works, which have recently been undergoing extensive additions and improvements, under the superintendence of Mr. T. T. Marks, A.Inst.C.E., the Engineer.

Our readers will remember that, by the Llandudno Improvement Act of 1876, the Commissioners were empowered to purchase the gas and water works, and the transfer was completed soon after the passing of the Act. On Nov. 26, 1877, the Engineer was directed to prepare plans of the alterations and additions required to be carried out, together with a report and estimate of the probable cost. These were presented at a meeting of the Commissioners on Jan. 16 last, and instructions were then given to proceed with the alterations, a description of which we append, derived from a little pamphlet presented by the Engineer to each of the visitors to the works, on the occasion alluded to above.

The coal-store is a rectangular stone building, 50 feet 6 inches long by 33 feet 6 inches wide by 9 feet 6 inches high, and will contain 300 tons of coal, which is equal to six weeks consumption. It is built with segment arches, and quoins of white splay bricks. It is roofed with two principals of pitch pine, slated, and made weather-proof. Its whole area is paved with blue Staffordshire bricks, and in the side are two ventilating louvres, for ensuring good ventilation. In connection with it is a weighing machine.

The retort-house is of stone, with corresponding quoins and arches, and is an extension of the old retort-house; it is 45 feet 6 inches long, 43 feet 6 inches wide, 19 feet high, and is covered with an iron roof, consisting of six principals, angle-iron rafters and longitudinal wind ties, the whole braced well together and set on stone templates. The ridge is open, and supports a ventilating louvre, 6 feet high, running the whole length of the building. There are two benches of retorts, consisting of ten beds, having four retorts each, or a total of 40 retorts, capable of carbonizing 15 tons of coal per day, or a maximum daily make of 135,000 cubic feet. The whole of this work is entirely new, with the exception of three beds on the north side, which, upon examination, were found in a condition to warrant further use. These have, however, been reset with new retorts and internal brickwork complete. Running the entire circuit of the building, and suspended by wrought-iron brackets, are 8-inch condenser-pipes. The paving is of blue Staffordshire bricks and Talacra stone, laid with a gradual slope from the centre, to facilitate drawing and charging operations, and to carry off surplus water, used in extinguishing the hot coke, into the ash-pans. Three cast-iron water cisterns are also provided.

To the right of the retort-house entrance, approached by means of an archway, is the men's room, which is 6 feet wide by 9 feet long, and has been built expressly for the convenience of the men employed.

The approach to the boiler and exhauster house is by a similar archway to the left. It is a brick and stone building, 25 feet long by 8 feet wide, and is paved with blue brick. A partition wall divides the boiler-house, converting a portion of its area into a small store-room. The boiler-house is roofed with pitch-pine principals, pierced to allow the wooden ventilating louvre, which is 4 feet square and 5 feet high, to be fixed. The boiler is a 4-horse power tubular boiler, fitted with water-cocks, steam-valves, blow-off cocks, and steam-gauge complete, and a steam-injector is attached for giving a constant supply of water. There is a Körting-Cleland steam-jet exhauster, with the necessary governor and bye-pass valves.

The condensers are formed of fourteen 12-inch cast-iron pipes, placed vertically, coupled with cast-iron bends of the same diameter, and provided with cleaning bonnets. The connections are placed on the surface, so as to be easy of access in event of stoppage, and a 2-inch overflow-pipe is placed at the end of the box, for removing the tar and water which empties itself into the tar-well. The foundations and base have been built with a due regard to strength, the whole of the ground being excavated to a depth of several feet, concrete taking the place of loose shingle, the base being brought up in brickwork, and terminating with a plinth formed in cement.

The two scrubbers are each 18 feet high and 5 feet diameter, mounted on cast-iron columns, and similarly constructed throughout. They are provided with the necessary water connections, dash-plates, tar-overflows, and syphons. The sides are pierced for four man-holes, secured by plates, cross-beams, and screws. Each one also has a man-hole on the top, to allow of inspection, and for charging. The connections are placed on the surface in the same manner as the condensers.

The purifier-house is built of stone, with the doorways formed with segmental arches and quoins in white brick, circular openings being left for ventilation. It is 32 feet long by 31 feet wide, by 16 feet high from the floor level, and is roofed with pitch-pine principals and slated with Welsh slates. A cellar is built beneath, 22 feet square, with suitable brick piers, on which the four cast-iron purifiers are erected. These are each 7 feet 9 inches square, and are so placed as to allow a gangway of 6 feet on every side. Each is provided with a wrought-iron cover with internal angle-iron trussing, terminating on the top with a strong iron bolt, which is forged into a ring, for lifting.

The escape of gas is prevented by the usual hydraulic seal or bite, and the covers are held down by suitable joined fastenings, kept in position by wrought-iron cotters. The lifting apparatus consists of four wrought-iron lattice girders, 1 foot 6 inches deep. These are formed of angle iron, with flat iron lattices and distance-plates; they have a bearing of 9 inches in the walls, and the ends rest on stone templates. The two carriages which travel the whole length of the building have been specially designed for raising and lowering the purifier-covers, and are complete in every detail.

The lime-house is adjoining, and communicates with the purifier-house. It is 32 feet long by 14 feet wide, and will contain 16 tons of lime, besides allowing 30 square yards for slaking purposes. It is paved with blue Staffordshire bricks, and is provided with cast-iron cistern and water supply.

The station-meter house is in the same block of buildings, and is 10 feet square by 8 feet high. The meter is mounted on a brickwork seating, lined with cement, and is capable of passing 5000 cubic feet of gas per hour.

The workshop is a stone building adjoining the meter-house, 18 feet long by 10 feet wide, and is paved with blue Staffordshire bricks.

The tar-well is constructed of blue Staffordshire bricks rendered in cement, well fronted, and made perfectly water-tight by means of puddle 18 inches thick. A partition wall is carried up within a short distance of the arch, to add strength. The internal dimensions are 15 feet long by 6 feet wide by 14 feet deep from bottom of inverts to soffit of arch, and will contain 6000 gallons of tar and ammoniacal liquor. It is provided with man-hole and pump for delivering the tar into contractors tanks.

The photometer-room is of stone, with quoins and windows and door jambs and heads of white bricks. Its internal dimensions are 16 feet 6 inches long by 10 feet wide. It is divided into two rooms by a brick partition wall. The small room, on first entering, is set apart for the gauges. Two ventilators are placed in the ceiling, to carry the products of combustion away into the atmosphere. On the table, 12 feet long, is placed

the photometrical apparatus to be used for testing the illuminating power of gas.

The store-shed adjoins the photometer-room, and is 24 feet 6 inches long by 13 feet wide, paved with blue bricks.

The two retort-benches have each a separate chimney. They are 42 feet 6 inches high, and built perfectly plumb, blue Staffordshire bricks being used in their construction. Fire-brick internal lining runs the whole height of the shaft, terminating with a neck mould and cap formed of white bricks and of neat design, which adds to its external appearance. The two shafts are the same height, exactly similar in construction, and erected on a solid concrete and stone foundation.

The governor-house is situated to the right of the entrance gates, and is 18 feet long by 8 feet wide and 8 feet high. Ventilation louvres are placed on the roof, to allow any escape of gas to pass into the surrounding atmosphere. It contains two cone governors for regulating the supply of gas. The small one is fixed on the 6-inch main, and the larger one on the new 12-inch main.

The gasholders and distributing mains have been subjected to a complete overhaul. The holders have been well scraped, each receiving two coats of tar, applied hot. All signs of incrustation and rust have been removed, and the several leakages which were found have been effectually stopped. The distributing-mains being in such a confused state, a complete re-arrangement inside the works was found absolutely necessary, and this has, though at considerable risk and with great difficulty, been effected, so that the liability to accident, which before existed, is now greatly reduced.

A new 12-inch trunk main has been laid from the works to the town. Each section of main was tested under great pressure, and found perfectly tight. Several alterations have been made in the street-mains, and others are in progress, with a view to equalize the pressure, which, when completed, will ensure to every part of the town a proper and unlimited supply of the gas.

After the inspection of the works, luncheon was served in the store-room, when Mr. E. Moore, who was Chairman of the Gas and Water Company, took the chair, and Mr. R. Price, the Manager for the late Company, and present Chairman of the Gas and Water Committee, was voted to the vice-chair.

Several toasts were proposed and responded to, and the proceedings, which were very successful throughout, terminated about half-past four o'clock in the afternoon.

GERMAN CONTINENTAL GAS ASSOCIATION.

A Meeting of the Board of Directors of this Association was held on the 4th inst., at which Herr Oechelhäuser, the General Manager, presented a report upon the satisfactory condition of the Association. The falling off in the consumption of gas that had taken place at the thirteen stations of the Association had been made up since June of the present year, especially in the manufacturing towns; while in the three additional German stations the ordinary rate of progress had not only been maintained throughout the year, but had even considerably exceeded that of the previous twelve months. The total increase in the consumption of gas sent out from all the stations, from the 1st of January to the end of October, was about 11½ million cubic feet, or 2·45 per cent. The Board had been compelled to take some decisive steps in opposition to the intended imposition by Russia of an import duty on Silesian coal.

The question of the electric light, of course, gave rise to considerable discussion. It was stated, however, that in the whole of the districts lighted by the Association, only four attempts had been made to introduce the light, even for manufactories, and in three instances, after several trials, for both long and short periods, had been made, the new system had been abandoned, and gas again employed; so that in only one case was the electric light still in operation. A long discussion then ensued as to the desirability of the Association obtaining authority, at the next general meeting, to undertake the supply of the electric light, and after considerable deliberation, and having in view the carefully prepared communication made by the General Manager respecting the experiments now being tried with the light, it was decided to adjourn the question until a suitable opportunity presented itself for a thorough examination of the subject, on technical as well as economical grounds. According to Herr Oechelhäuser's published statements, he was strongly of opinion that there were other systems of electric lighting superior to the Jablochkoff candle, which, as far as his own experience of its cost was concerned—and his calculations had not yet been questioned—certainly could not compete with gas.

The chief argument against the proposition of the Association becoming suppliers of the electric light was to be found in the fact that, according to the natural law of the transmission of an electric current—a law which no inventor could alter—it was absolutely impossible to produce electricity at central stations similar to the present gas-works, and conduct it by main and branch wires into the consumers houses. Nothing but the possibility of realizing that happy notion could endanger the business of gas companies. This, however, did not appear likely to be ever carried out, inasmuch as it was opposed to the law that by doubling the length of a conductor of an electric current, its diameter must also be doubled. Consequently, the weight and cost of the copper wire do not increase in simple ratio, but in that of the square of the distance. If, for example, a wire of 30 kilos. (66 lbs.) in weight suffices for a distance of 100 mètres (about 109 yards), 1000 mètres (1090 yards) would not require 10 times, but 100 times the weight—viz., 3000 kilos. (6600 lbs.) of copper. An estimate had been prepared, and was produced, showing how much copper would, according to this law, be required to replace all the gas lights in Berlin by the electric light, supposing the six existing gas-works were converted into stations for the production of electricity, for which purpose they would each have to be provided with a steam-engine of from 5000 to 6000 horse power. The average distance of these works from the centre of the town was 2600 mètres (or rather over a mile and a half), and one-half of this (1300 mètres) might be taken as the average distance of the works from the lights. Now, according to the formula of Brèguet, the constructor of the Gramme machine (which requires thinner wire than Siemens's), a single electric light on Serrin's system, placed at a distance of 300 mètres from the dynamo-electric machine, requires a copper wire of 7 millimètres (0·28 inch) diameter, which, including the return wire, would weigh 200 kilos. (440 lbs.). In proportion, therefore, to the distance of 1300 mètres (say three-quarters of a mile), each single electric light would require a double wire of 20 millimètres (four-fifths of an inch) diameter, weighing 3755 kilos. (nearly 74 cwt.), and costing 11,265 marks (£563 5s.). Assuming an electric light to be equal to 30 gas-jets (an average, however, which experience had shown to be too high), 23,000 of such lights would be required in order to replace the 700,000 gas lights at present employed in Berlin, and for this purpose 86,300,000 kilos., or something like 84,500 tons of copper wire, the value of which might be estimated at 260 million marks, or £13,000,000 sterling, would be necessary for conducting the currents. This quantity of copper was ten times as great as the yearly production of that metal in the German Empire. The Jablochkoff system might require a somewhat thinner wire, but in so large a quantity this would be of little consequence. It was evident, therefore, that the application of the electric light must either be restricted to separate establishments, or to blocks of buildings lying closely together; but inasmuch as a number of small stations for the generation of the currents would be exceedingly difficult to manage, and the operation generally would necessitate the employment of a large number of skilled workmen, it was very questionable whether gas companies could make it worth their while to undertake the supply of the light.

According to the latest opinions of several of the most eminent electricians, the electric light was applicable only in certain special cases, and therefore it could not possibly be hurtful to gas interests. It was now a year and a half since gas shareholders began to exhibit alarm concerning the light, and Herr Oechelhäuser was sent to Paris expressly to study the subject. His observations and the calculations he had made had not, up to now, been disproved, and his remark, that "the farther the division of the electric light extends, the greater the cost of its production appears to become," was very encouraging. The greater divisibility of the light now attained had, so far, in nowise strengthened its chances of successfully competing with gas for the purpose of general illumination; but, on the other hand, had decidedly lessened them.

AMERICAN GASLIGHT ASSOCIATION.

[Condensed from the "Official Report" in the *American Gaslight Journal.*]

(*Continued from page* 933.)

Mr. G. A. M'Ilhenny (Washington, D.C.) read the following paper on

THE GOVERNMENT OF GAS-WORKS.

In the management of all undertakings, organization is of the first importance, and in no kind of business or manufactory is this of more importance than in the production and sale of illuminating gas.

You will observe that in the manufacture and sale of gas there is, perhaps, a more close and intimate relation than in almost any other kind of traffic, because the great difference between the amount made and that sold involves so large a moneyed consideration. Again, the character of the business is unlike almost any other in the variety of knowledge necessary to secure successful management, there being mechanical as well as chemical knowledge required—business and executive ability necessary. In view, then, of the great value of proper organization to a business of this kind, it is proper here to remark that there is, perhaps, no interest involving so much pecuniary consideration, where there is a greater variety of organization, or less concert; as it is but seldom found that two companies are working in the same way. While circumstances may require some difference in the management, there is no excuse for the great diversity in the method of conducting this business (if any system can or ought to be taken as a standard); and that there should be some rule regulating this, as in all other important matters, is manifest.

Companies are usually organized with a board of directors as the governing powers; and they, in turn, elect one of their number as president, also a secretary, and sometimes a superintendent, but frequently this officer is appointed by the president. The board of directors can have but little to do with the detail management, and, of necessity, look to their officers for the performance of all necessary duties. The president, being the head of the company, is properly and rightfully the ranking officer; and in the selection of a man to fill this important position the greatest care should be exercised, in order to secure one who combines all the qualities required; and these, I assume to be, first of all, good common sense, active business energy, a knowledge of banking and finance, a man generally well informed, and, of course, a gentleman. If you can combine these qualities with social and financial standing, mechanical and engineering or chemical knowledge, you have a man eminently fitted for the place.

The secretary is also an important officer, and the choice of this man should be made with great care. He should be a man with uniform urbanity of manner, good and courteous address, intelligent, popular with the public, and familiar with the social and financial standing of the consumer—a man acquainted with general business matters, energetic and honest, with executive ability. Of course, it is much easier to describe these qualities than to find them; but we are now endeavouring to fix a standard.

The superintendent—and this I assume to be the proper title for a manager of gas-works; that of "engineer," so commonly applied to the holder of this position, is frequently erroneous, because, in many instances, managers have but little knowledge of engineering, and when that quality is required, some other person is called upon to supply it. I claim, moreover, that "superintendent" is a title of more dignity and propriety than engineer; but when the manager acts in the capacity of both, then his title should be engineer and superintendent.

The qualifications of a superintendent should be mental and physical vigour—both are indispensable. He should have a comparatively extensive knowledge of the several branches of science relating to his business; he should be a good mechanical engineer, understanding, and having a knowledge of both rough and fine work; and if he were a practical mechanic, machinist, or millwright, it would be to his advantage. He requires a knowledge of building in stone, wood, and iron-work. He must, of course, understand how to construct every part of his works, and, if necessary, ought to be able to do it himself. He ought to know how to manipulate his material for the production of crude gas, and when he has done this, he must be familiar with the means of condensing and purifying it. He ought to have the faculty of managing men, and should have much force or executive capacity. Because of his intercourse and dealings with the public and corporate bodies, he should be a man of good address and agreeable manners, and understand well the relationship of his company to the public, in order to best protect its interests. His intelligence and position, as executive officer of an important institution in the city or town in which he lives, should enable him to secure and retain a first-class social standing; this is desirable in every man's case, and it is particularly so in that of the manager of gas-works.

Having endeavoured to describe the qualities that should be possessed by the principal officers, I now propose to define their respective duties.

First, we will refer to the president, who, when he is placed in his high and responsible position by the owners, is expected by them to guard well their interests; and under the influences by which those gentlemen are frequently elected, the necessity of proper organization is apparent. We are all aware that men are as often chosen, to fill this important place, for expediency as for special qualifications, and in many cases are chosen from business circles without any previous training, or mechanical or engineering skill. I do not say that this is not sometimes right, and the best selection is doubtless made that can be made by a board of directors who are looking for results and dividends by means of some astute manipulations; and frequently, as in all kinds of business, the right man is selected, and the company are to be congratulated who make this lucky choice, because so much depends on him. The duties of the president I claim to be a general supervision of the entire affairs of the company, without any special detail to perform himself; and in the division of this work, he ought to have but two responsible heads—the secretary and the superintendent. To the first belongs everything relating to gas after it

leaves the burner—such as the control of every man, clerk, meter-taker, and other person in his office, keeping all accounts, collecting all moneys, and looking strictly after the correct registration of the meters, by requiring his assistants to make careful comparisons, and report any apparent defects. His office should be conducted on the best, simplest, and yet most comprehensive system; and it is of great importance that some uniform method should be adopted and applied to this important branch of the business.

In order to ascertain the best system for the conduct of this branch of the business, the president and secretary should examine the methods of other companies, visit other cities, and get a personal knowledge of the workings and systems in use, and should adopt whatever of their methods would be suitable and useful to them. It would, perhaps, be difficult to establish an exact rule to apply to the manner of conducting the business of the secretary's office, as circumstances will probably require some difference in nearly every place, and it is not absolutely necessary in this case, so that an efficient and comprehensive system be adopted.

It is in the execution of the duties that the effort should be made. The secretary should, as has been said, have control of all the details after the gas leaves the burner, and for the performance of these duties the president should look to him. Neither the president nor any other person should interfere in the details, by giving orders independent of the chief officer, because such conduct always tends to lessen discipline and create confusion. The president and directors should enforce their rules through the proper officers.

The custody of the money should be entrusted to a treasurer, who will give the necessary bond. All moneys should be paid over to him by the clerks or collectors, as the case may be, and a receipt given by him to each man whenever payment is made. A receipt book for this purpose should be provided. The treasurer's accounts ought to correspond with the amount of gas sold, less the delinquent bills. A bank or banks should be designated by the board of directors, in which he shall deposit the money; and when this is done, and proper returns made to the secretary, his responsibility ceases.

All payments should be made by checks, drawn by the secretary and countersigned by the president, and all bills for which checks are given should be approved by the proper officer—by the secretary when contracted for his department, and by the superintendent when belonging to his department; and no payments should be made except upon properly certified vouchers.

The success of the company will depend largely upon what is known as results, which means chiefly the manufacture and sale of gas; and the management in this direction will be a guarantee for either success or failure. Indeed, it may be said that the very existence of the company depends on this. Hence the great necessity for having the very best management in this department that can be obtained. And there has perhaps never been a time in the history of the business when the necessity for this has been more apparent than now, because of the tendency for cheaper gas, and the rivalry of other lights.

I have previously stated, in defining the duties of the secretary, that he should have charge of everything after the gas has left the burner; and now, in defining the duties of the superintendent, I claim that he should have charge of the gas before it leaves the burner, which covers all the details of manufacture and distribution. He should employ and discharge every man in his department. His authority to purchase will depend largely on the confidence of his company in his judgment and ideas of economy. He should have control of the manufacture and distribution, and be responsible for both. Coal purchased should be paid for by the weight received at the works, and all coal sent into the retort-house should be accurately weighed, and the account proved once a year, by working out the coal received, or obtaining, by exact measurement, the weight of that on hand—that is, the coal account should balance at the end of the year.

It is obvious that the great effort should be to sell the maximum amount of gas, of proper quality, per ton of coal; and to secure this end it is of the utmost importance that the manufacture and distribution be under the control of one man, because when more than one is managing it, there is a divided responsibility, and there cannot be other than confusion of counsel and conflict of opinion, if not of authority. Two captains cannot sail the same ship, nor two men manage a gas-work. There must be a head which will have the authority and responsibility.

The most important part of the superintendent's duties is at the works; here is where the most of the money is either lost or made, and to this part of his business he should lend the principal portion of his ability and energy. The works should be his head-quarters, and there nearly all his time should be spent. Even if he has nothing particular to do, his presence is needed to influence others; and it is highly important that he should have a personal knowledge of everything that transpires. To have this he must see it. It is a mistake, which is often made, to suppose that gas-works can be managed successfully from an uptown office, or by a telephone. Nothing but the strictest personal attention will secure the best results; nor can chance be relied on to produce these: they come not in this way, but are the result of study by day and night. Indeed, the intelligent and thoughtful superintendent never loses sight of his business; his mind is always active, and no opportunity is allowed to pass where he can improve his company's condition.

The necessary power and authority being placed in his hands, his responsibility is, of course, in proportion; and, having obtained the power he requires from the president or directors, it then becomes a serious question what they shall expect of him. What they have a right to expect and demand is, in the first place, the very best general management. As to results, there should be no excuse offered, nor any accepted, for failure; on the contrary, I am of opinion that a standard of results ought to be established by each company, such as—gas sold, make per man and retort, and cost delivered to the consumer. This can easily be done by taking the best results of other companies, and requiring the superintendent to equal them; because there is no reason why as good results cannot be made in one place as in another where the same, or as good material is used. If there are difficulties, he should overcome them, except, perhaps, those of a climatic nature. I believe this is the best method of bringing about the highest results.

As the president has but one man to look to, if he (the president) knows what is required, and the superintendent fails to fulfil the standard, he must admit his failure, and might realize that he had missed his calling. It cannot be other than gratifying to a superintendent to know that his results are among the best, for they are his stock-in-trade, his capital; and it is equally as much to his interest as to that of his company that they should be the best, because they never fail to be appreciated.

In this, as in all other callings and professions, there are some men who have superior capacity, and it cannot be expected that a superintendent can acquire all necessary knowledge at home, or in the city in which he lives. This would be unreasonable. Therefore, the company should afford him every opportunity for obtaining information, by sending him to other cities in the country, and it would be to his advantage if he were permitted to investigate works in foreign countries. He may get but few ideas, but he is certain to learn something that will be useful in his business, and it will take but very little in this respect to fully compensate his employers for the small expense incurred. Aside from the advantages secured by general information, anything that facilitates the acquirement of knowledge on his part is sure ultimately to redound to the benefit of his employers.

It becomes a question how men possessing this merit in the gas profession should be compensated, because it is clear to me that they should share in the emoluments that their abilities have secured for others. This principle is one recognized in nearly every vocation in life. A successful statesman, soldier, or patriot is rewarded by his grateful country; the lawyer, doctor, and mechanic, who possess superior abilities in their various occupations, are generally rewarded by their large fees and extensive business; and in the mercantile line, men possessing ability or influence, which in that business amounts to the same thing, are taken into partnership, or in some way recognized.

In the gas profession, however, no opportunity is given to the manager to share in the profits, no matter what his success may be, except by his compensation in salary. This sometimes is liberal, but often otherwise. It is but seldom that the superintendent owns much of his company's stock, and he generally remains so poor that, no matter what may be the prospective or actual profit, he can get none of it.

Now, in view of these facts, it seems to me that there ought to be some rule or custom established, allowing a certain per centage of the value of results, after they reach a certain limit, to go to the superintendent; and while this would be only simple justice, it would stimulate men to make extraordinary efforts, and the man who failed to accomplish something under such circumstances might be truly pronounced a failure.

The organization, then, will be as follows:—The superintendent to have charge of everything until the gas leaves the burner, and the secretary to have charge of everything connected with his office after the gas leaves the burner—both to be responsible to the president, and neither to interfere with the duties of the other. If either fails to meet the requirements demanded by his office, the president has but to show this, and hold each to a strict accountability. Of course, the performance of these duties will depend largely upon the capacity of the president to determine when they are properly executed, as he ought not to accept less than agreed upon, or expect more.

Mr. Cartwright: There seems to be some misunderstanding in regard to a phrase in the paper just read, and it may perhaps be well to have it explained. Mr. M'Ilhenny spoke of the control of the several officers he has named ending with the burner. I think it would be satisfactory if he would make that expression a little more explicit. Does he mean that the control ceases at the end of the burner, or when the gas leaves the burner?

Mr. M'Ilhenny: The language used was that the secretary should have charge of everything after the gas leaves the burner, which includes all the bills, and that the superintendent should have charge of everything before the gas leaves the burner, which includes everything up to the time the bills are made out—meters, street-mains, works, and all the details incident to the production and distribution of the gas. I make the burner the dividing line between the duties of the superintendent and the secretary. Of course, I am not laying this down as a rule. I do not suppose there are many who will follow it; but it seems to me that, in order to simplify these things, and get the best results, it is necessary to divide the responsibility in some way; and I have done it by making the secretary responsible after the gas is registered, and the superintendent responsible before it is registered.

Mr. Herzog: There is one thing to which Mr. M'Ilhenny refers, and which he desires should be introduced here, that has been put into successful operation in some large Continental gas companies, and that is, giving the superintendent a share of the profits, to a certain extent. Some of the large companies pay their superintendents a small salary, and at the same time give them a per centage of the earnings. I believe that is the just and fair way for companies to do, and it has worked very successfully there.

Mr. Neal: I really do not think some of the members understand what Mr. M'Ilhenny means by the secretary having charge of the gas after it passes the burner.

Mr. M'Ilhenny: I stated in the paper that the secretary had charge of the clerks and meter-takers, and all the details incidental to the collection of the bills; that the money was to be paid to the treasurer, and that he was to deposit it, and make a correct return of it to the company.

A vote of thanks having been passed to Mr. M'Ilhenny,

Dr. T. O'Connor Sloane (Brooklyn) read a paper, entitled

THE RELATIONS OF LIGHT AND HEAT IN GAS-FLAMES.

It is well known to us all that heat, in its industrial applications, is wasted to a great extent. The old problem of the conversion of heat of low into corresponding heat of high temperature, has to be solved, and to its non-solution the waste in most cases is due.

Theoretically, one pound of coal should melt forty pounds of iron, yet this result is never even approached in metallurgical practice.

I wish to examine very cursorily the loss of heat in a gas-flame. Light is here produced by the intense heat. The combustible gases are peculiarly fitted to produce such heat, because, as they are already in the gaseous state, they do not, in their combustion, have to make the step from solid to gaseous, as solid combustibles do.

The light given by the flame is due to the ignition of particles of solid matter. Carbon is present in the unignited gas in combination with hydrogen, as constituent atoms of gaseous hydrocarbon. When the gas burns, the heat of the flame decomposes these compounds; solid carbon, in a state of almost molecular division, is liberated, and becoming white hot, or incandescent, emits light. It travels upward through the flame, until, reaching the top and outer zones, it is burnt into carbon dioxide, commonly called carbonic acid gas.

All the light of gas is due to the ignition of this carbon. The proof of this fact is, that while gases and liquids ignited may give light, it can always be determined by spectroscopic analysis whether light is due to an ignited gas or not. Theoretically and in fact, the spectrum of light derived from the ignition of a gas is discontinuous, while liquids and solids ignited give a continuous one. On subjecting the light of illuminating gas to this examination, it is found that it is due to the ignition of solid or liquid matter, because its spectrum is continuous. As there is no reason for the belief or probability that there is a liquid there present, we find that its light is derived from an ignited solid, and, by analysis, we find that carbon is the only substance present that remains in the solid state at elevated or even ordinary temperatures.

This proves the fact. A *quasi* proof is found in the deposition of carbon, in the form of lamp-black, upon a cold body immersed in the flame. Therefore, as a light-producer, all the work of a flame is the heating of carbon to a white heat.

I shall now proceed to consider the arithmetic of the process, to show what waste of heat takes place, and what a sacrifice of economy to convenience the whole operation is.

I will start with a gas composed of the following principal constituents:—

	By Weight.	By Volume.
Hydrogen (H)	5·00	50·00
Marsh gas (CH_4)	63·00	39·40
Carbon monoxide (CO)	19·00	6·70
Olefiant gas (C_2H_4)	11·00	3·93
Water (H_2O)	2·00	1·11

This represents about such a gas as is now delivered in New York. For ease of calculation, I will use the analysis by weight, and refer everything to 100 parts of the gas.

The olefiant and marsh gases supply the flame with its solid carbon; and, to make every allowance, we will assume that all the carbon contained in them is dissociated, and plays its part in producing the light of the flame. They contain 56·67 parts of this carbon. The heat developed by burning each of the combustible gases has been determined by physicists. If we multiply the amount of hydrogen and other combustible gases, each by its own heating power, we shall have the total heating power of the flame. Thus, one part (by weight) of hydrogen will raise 34,462 parts of water one degree centigrade; therefore, $34,462 \times 5 = 172,310$ is the number of parts of water which the five parts of hydrogen in the gas under consideration will raise one degree centigrade in temperature.

Performing a parallel computation for all the constituents that will burn, we find that 100 parts of the gas will raise 1,169,317 parts of water one degree centigrade. 1500° centigrade is not far from the temperature of the incandescent carbon. We will assume that this number of degrees of heat has to be imparted to the carbon by the flame. Dividing 1,169,317 by 1500, we have 779·5, the number of parts of water which 100 parts of gas will raise 1500° centigrade. But 100 parts of this gas, in their combustion in air, will have to heat 815 parts of nitrogen derived from the atmosphere. Multiplying this number by 0·2438, the specific heat of nitrogen compared with water, we obtain 198·69, the corresponding weight of water. This, *plus* the water in the gas, must be subtracted from the total work. Doing this, it gives as a result that 100 parts of our gas should be able to raise 578·8 parts of water 1500° centigrade. If we divide this number by 0·2411, the specific heat of carbon, we shall have the corresponding weight of carbon, or 2400. Dividing this (the theoretical) by 56·67 (the actual) efficiency of gas, we obtain 42·4 as the figure expressing the relation of theory to practice; in other words, the gas in its combustion generates enough heat to produce 42·4 times the light it does.

The efficiency of gas I have determined on the supposition that all the carbon in the marsh gas plays its full part in the illumination. But this is not true; the light is due almost entirely to the olefiant gas. The supposition that it is the carbon of this constituent mainly that is dissociated and made incandescent, is more than probable.

This carbon in the gas under consideration amounts to 9·43 parts. Substituting this figure for 56·67 in the former calculation, our ratio of practice and theory is expressed by 254·50; or the gas generates enough heat to produce 250 times the light it actually does. This figure seems—and I am not at all ready to say it is not—extravagant; but even if it is so, the other one, the first deduced, is too small. The truth lies somewhere between the two, and indicates at least a field for experiment.

A short conversation followed the reading of the above paper, after which Major Dresser exhibited and explained the working of a Jablochkoff "candle."

A vote of thanks was then passed to Dr. Sloane for his paper, and the Association adjourned till next day.

FROZEN GAS-METERS.

In the *Globe* of Thursday last appeared the following in reference to this question:—

"While hosts of inventors are intent on giving the world such a light as it has never seen, we trust they will include within the scope of their inquiries the practicability of ensuring meters against becoming frozen. The provincial papers are full of complaints from suffering householders on this head, Leeds, especially, being very much afflicted; to such extent, indeed, that the Gas Department of the Municipality is almost unable to cope with the multitudinous grievances which come pouring into its offices every day. This is one of the cases in which the public would do well to act for themselves in the first instances. By covering a meter with some material such as woollen cloth, scraps of carpet, hay, or straw, it will be protected against many degrees of frost. But great care ought to be taken that the covering remains perfectly dry, because when wet it acts as a refrigerator. A gas engineer recommends another preventive, should the cold be so severe as to penetrate through these defences. His suggestion is that 2 feet of gas per hour should be burned, even during daylight, when the meter is a three-light one, and more in proportion to the increased size of the meter. The object is to keep the mechanism constantly at work by day and night. To those who would like to experiment with the plan, it may be as well to mention that the consumption of 2 feet per hour would cost about a penny a day, and would give a permanent flame from a single burner, about half the size of the ordinary flame. There is, however, one objection to the proposal, which, in the opinion of most people, will appear insurmountable. It is the general custom of householders to turn off the gas on going to bed, in order to prevent ill consequences from a chance escape during the remainder of the night. Unfortunately, it is between midnight and daylight that the thermometer generally registers the lowest temperature. If, therefore, a householder kept the permanent light during these hours, he would incur the risk of an explosion; if he did not, the previous consumption of extra gas would not prevent the meter from being frozen. In presence of this dilemma, it will be judicious to adhere to the old methods of prevention, which generally prove efficacious during even more severe weather than we have yet experienced this winter. At all events, they involve no additional expense—a matter of some moment to many households just at present."

In Saturday's issue the subjoined was published:—

To the Editor of the "Globe."

"Sir,—I observe in your paper of last night that some of the large provincial towns are subjected to great inconvenience by the freezing of their wet gas-meters, and you advise them to protect their meters from the frost, by covering them up with carpets, straw, or some non-conducting substance; and also to keep them in action by burning one or two lights. These precautions would retard, but not prevent the freezing of wet gas-meters. The only effectual remedy is to replace the wet meters with dry meters, in which there is no water to freeze. The town of Leeds, to which you refer, and also Liverpool and Birmingham, continue to use wet gas-meters. Dry gas-meters have for many years been used extensively in the Metropolis and in most other towns. The Gaslight and Coke Company—the largest in the world—now use almost exclusively dry meters. The consequence is they have few complaints of want of gas, and certainly their office is not besieged like those of the large provincial towns referred to. A prejudice has arisen in some minds, from the number of cheap and defective dry meters in the market. Of course, like watches, they can be got at all prices and qualities. People who want a good watch buy it from a maker of known repute. A good dry meter can be got at a cost not greater than wet meters. A wet meter which has been once frozen ought not to be used until it has been overhauled and repaired, as the expansive force of the water in freezing has warped the internal parts of the meter, and not unfrequently the meter is further injured by the hasty and unskilful method of thawing it.—Yours, &c.,

"*Dec.* 27, 1878." "JOHN FROST.

THE LANCASHIRE COAL AND IRON TRADES.

(FROM OUR OWN CORRESPONDENT.)

There is not much change to report in the condition of either the coal or iron trade of this district, and with the exception of those classes of round coal suitable for house-fire and gas-making purposes, there has been very little business doing, many of the works being already closed for the holidays and stock-taking, and there will not be much doing until after the first week in the new year.

The chief feature in the coal trade has been the great difficulty experienced in obtaining supplies, the transit of coal over both the railways and the canals having been almost entirely stopped by the fogs and frosts, whilst deliveries by road have been almost equally difficult, and merchants and dealers have, in some cases, taken advantage of this exceptional state of things, to demand higher prices, although the quotations at the pit mouth have been without change. In the gas coal trade there has been a heavier demand than usual upon cannel, owing to the extra pressure which has been felt by the gas companies, and in some cases this class of fuel has alone been used. In round coal for steam and forge purposes, and burgy and slack for engine purposes, there has been no better demand, and considerable quantities of these descriptions of fuel are being thrown upon the market by the stoppage of many of the iron-works, and the depression in the cotton trade. The quoted prices at the pit mouth remain about as under:—Best round coal, 9s. to 10s. per ton; seconds, 7s. to 8s.; common round coal, 5s. 6d. to 6s. 3d.; steam and forge coal, 5s. to 5s. 6d.; burgy, 4s. to 4s. 6d.; and slack, 2s. to 3s.

In the iron trade, a few small truck orders, to cover pressing immediate wants, represent the bulk of the business doing at present; but there are inquiries for delivery over next year, and, where sellers are prepared to take present prices, sales can be effected.

The wages dispute, so far as the engineering branches of trade are concerned, seems to be in a fair way of settlement on something like the basis proposed by the masters of a reduction of 2s. per week.

THE COAL AND GENERAL TRADE OF THE NORTH OF ENGLAND.

(FROM OUR OWN CORRESPONDENT.)

Contracts for the supply of gas coals over next year are being entered upon more freely by gas-works at home, and also on the Continent. The best gas collieries are fully employed, and have been so over the year. The price of gas coal continues unchanged—say, 7s. per ton best, less 2½; seconds, 6s., less 2½. The demand continues to be made upon best gas coals; medium qualities, however, occupy a very good position in the market. Inferior gas coals are scarcely looked at; they can hardly be called gas, because a good few of the collieries were commenced to work manufacturing coal for local consumption. When the factories and iron-works are so badly employed, it is attempted to find a market for the coals as gas; but as the freight for a ton of best coals is the same as for the worst, companies naturally prefer the best, and buy them. The steamers *Westminster* and *Vauxhall*, which were specially built to carry gas coal above London Bridge, have been well tested this year, and have proved themselves, both as regards seaworthiness and speed and as river boats, easy to handle. The other branches of the northern coal trade are without change. There is every prospect of any quantity of coals of all description being in abundance in the market next year. It is pretty clear, however, that prices have reached their lowest point. Anything below present rates would cause one-half or two-thirds of the collieries to be closed.

Coasting rates have fallen very considerably; the figure for steamers to take coals to London does not exceed 4s. 6d. per ton, whereas last week 5s. 3d. to 5s. 6d. was the figure. Sailing vessels to discharge gas coals at the wharves in the Thames are asking 6s. 6d. per ton. Within the last few days there have been large arrivals of light sailing ships in the Tyne and Wear. Shippers are indisposed to pay the rates asked. Channel ports are down from 3d. to 6d. per ton, and rates are less by 3d. per ton for the East coast.

The manufacturing trade of the North of England remains in the same dull, impassive condition of which I have written from time to time during the year. There is no immediate sign of any improvement. There is not so much abject misery amongst the working classes of the North as in other parts of the country. The bulk of the men find work of some kind or other—say about three-quarter time is about the rule throughout the trades. A considerable number of men who have work have been kept out of it for the greater part of December, through the intense frost and heavy falls of snow which have prevailed.

TRADE NOTES FROM SCOTLAND.

(FROM OUR OWN CORRESPONDENT.)

A special meeting of the Kirkintilloch Police Commissioners, sitting as Gas Commissioners, was held last Tuesday, when the proposed mortgage of £16,000 upon the gas-works was submitted and agreed to, and the Clerk was instructed to get it completed in the terms of the Burghs Gas Supply (Scotland) Act.

The adoption of the Act by the Johnstone Burgh Commissioners has given rise to a considerable amount of dissatisfaction amongst the ratepayers, now that they find they have to pay (in the opinion of many persons) "dear for their whistle." It is understood that the Commissioners have appealed against the Arbiter's decision, as provided for in the terms of the deliverance.

At a meeting of the Works Committee of the Dundee Gas Commission, held on Friday, to consider what experiments should be made with the electric light in the town, it was stated that Mr. Lowdon, of Nethergate, was shortly to receive from London a large Gramme machine, and various kinds of lamps, including a large one similar to those used for the lighting of the Thames Embankment. It was not thought necessary, in the meantime, to send a deputation to London in connection with the matter; but it was arranged that, when the machine and lamps arrived in Dundee, experiments should be made with them at the Albert Institute.

In the course of a very interesting address which he delivered last Friday night, as Chairman of the annual festival of the Dundee Gas-Works *employés*, Mr. B. M. M'Crae, the Manager, spoke very confidently of the future of coal gas. He admitted that he was now getting pretty old, but he meant yet to be selling gas in Dundee at 3s. per 1000 feet; indeed, if he had his department as perfect as he desired, and as perfect as it might be, the gas would be 3s. per 1000 feet next May. There was, he said, as much gas lost in the streets and within people's houses as would now bring down the price to 3s. 2d.

At a meeting of the Annan Police Commissioners, held last Monday, Provost Nicholson moved that application be made to the Public Works Loan Commissioners, through the Board of Supervision, for leave to borrow £8000, to carry out a system of water and drainage in the burgh. Bailie M'Lean moved as an amendment that no application be made till a *plébiscite* of the ratepayers had been taken on the question. On a division, the amendment was carried by eight to six, and it was resolved to have a *plébiscite* taken as soon as possible.

A meeting of the Musselburgh Water Trust was held last Tuesday, when a letter was read having reference to the proposed supply of water for the burgh. Several members strongly objected to the proposal to charge for the water a rate not exceeding 6d. per 1000 gallons, and it was ultimately agreed to consult Mr. Buchanan, C.E., of Edinburgh, before coming to any decision on the point.

The Irvine water supply scheme is likely to cost not less than £42,000, notwithstanding the fact that the original estimate was £24,000, exclusive of land claims. Already the sum of £34,000 has been borrowed from the Public Works Loan Commissioners by the two Local Authorities—Irvine and the Halfway—and it has just been resolved, on the part of the Halfway, to borrow £5000 additional. The proportion which each Authority are to pay of the total cost of the scheme has been left for Sheriff Campbell to decide.

The Glasgow pig iron market was in a very anomalous condition last week. A very large business was done in iron for immediate delivery, principally squaring off the "bear" account; while iron for forward delivery, at lower prices, was quite neglected. As high as 43s. 9½d. was paid on Monday, and down to 43s. 3d. cash on Friday. At the close, in the afternoon, there were sellers at 43s. 5d., and buyers at 43s. 4½d.

The coal market shows no elasticity. All descriptions remain quiet, more especially those preferred for shipping. The local trade has quite slackened off for the year, and until the holidays are over and works re-commence, there will be increased quietness; but it is to be hoped that all trades may have more prosperity during the coming year. Prices continue to be very low.

Dorchester Gas and Coke Company, Limited.—This Company was originally constituted by Deed of Settlement, dated March 15, 1833, and was registered under the Companies Act, 1862, as an unlimited company, on the 5th of September last. In accordance with a resolution passed at an extraordinary general meeting of the Shareholders, held on that day, the Company was incorporated on the 18th inst. as a company with limited liability. The capital is £17,000, in fully-paid £10 shares, the whole of which are divided amongst 100 members.

Death from Gas Poisoning near Edinburgh.—Early on Thursday morning, the 19th inst., a plumber, named William Christie, was found dead in the wooden box which encloses the gas-meter situated near the railway signal-house at the mineral wharf, Granton, near Edinburgh. It appears that the supply of gas to the wharf had been stopped for a day or two, and that Christie had been to look after the meter and connecting-pipes. When examined, it was found that the pipe leading from the main was disconnected from the meter, and this had evidently been done by deceased, for the purpose of curing the defect, and the strong flow of gas which had resulted had apparently overpowered him.

A Caution to Collectors.—The Chief Collector of the Water-Works Company at Bristol is in an embarrassing position. He had £500 in hand when the West of England Bank closed on Saturday afternoon, and was allowed to place it in the strong room till Monday, intending then to "pay it in" to the account of the Water-Works Company. The bank did not open on Monday, and the Collector asked for the return of his money. The question was referred to the Liquidators. "We cannot give up a shilling of the assets of the bank," said Messrs. Turquand and Clarke. "Very well, then," replied the Collector, "allow it to be placed to the credit of the account." "That cannot be done now," answered the Liquidators, "it ought to have been done on Saturday." "Well, then, give me a receipt for it." "We give no receipts for anything. We simply take possession of everything we find in the bank;" and thus the Collector is left without his £500, without a receipt for the money, and with a blank in his pass-book where the entry ought to be.—*Mayfair.*

Purchase of the Weston-super-Mare Water-Works.—At the meeting of the Town Commissioners of Weston-super-Mare, on Monday, the 23rd inst., the minutes of the Committee of the whole Board, and of the Water Supply Committee, with reference to the purchase, by the town, of the works of the Weston-super-Mare Water Company, were presented. The rules with reference to the transferring of the works and the transmission of debentures, and the fees to be paid thereon, having been adopted, the Board approved and authorized the issue of 1300 debentures of £50 each, with coupons attached, to three Directors (Messrs. Alfred Hill, George Frederick Powell, and Julian Hill) of the Company, for securing the payment of £65,000, with interest thereon, to the Company, for the purchase of their undertaking. The seal of the Board was subsequently attached to the debentures, and also the signature of the Clerk. The formal transfer of the water-works to the Town Commissioners took place on Thursday last, when a banquet in celebration of the event was given by the Directors of the Company.

Presentation to Mr. W. A. Valon, of Ramsgate.—On Saturday, the 21st inst., the *employés* at the Ramsgate Local Board Gas and Water Works presented the Engineer, Mr. W. A. Valon, with a silver cake-tray, biscuit-box, flower-vase, and glass claret-jug mounted in silver, each piece bearing a suitable inscription. Mr. R. Thorpe, the foreman, addressed the recipient, on behalf of the men actually engaged on the works, in the course of which he alluded to the good feeling that had always existed between the Manager and the workmen employed, and said he had no reason to doubt its continuance. After expressing a wish that Mr. Valon might be spared for many years, and that health, prosperity, and happiness might attend him and the whole of his family, Mr. W. Friend, as representative of those engaged outside of, but in connection with the works, in a few appropriate terms endorsed most cordially the sentiments expressed by the previous speaker. The testimonial was then handed to Mr. Valon, who received an enthusiastic ovation, and, in returning thanks, said he had always endeavoured, while maintaining strict discipline, to study the welfare of the men; in fact, he must do so, the interests of the Board and those of the *employés* being identical. It was especially gratifying to him to find he had so far succeeded, and they might rely upon him doing what he could to retain their good-will for the future.

The Gas Interest Abroad.—At the last meeting of the Shareholders of the Central and South of France Gas Company, a dividend of 56 frs. (£2 5s.) on each fully paid-up share was declared on the year's working ending March 31, 1878.—At the recent general meeting of the Cherbourg Gas Company the accounts for the year's working were approved. They admitted of the payment of a dividend of 95 frs. (£3 16s.) per share.—The past year's operations of the Lausanne Gas Company have not been so successful as those of previous years, the consumption of gas not having increased in the usual ratio. The sales of gas increased by 7000 frs. (£280) only; the coke produced 14,000 frs. (£560); less and the cost of coal was 23,000 frs. (£920) less than that of the previous year. The profits, however, permitted of the payment of a dividend of 30 frs. (£1 4s.) per share in addition to the 5 per cent. already paid, being the same as the previous year. The capital of the Company is only 700,000 frs. (£28,000).—From the report presented by the Board of Direction of the Naples Gas Company, we learn that the past year's working has resulted in a profit of 471,566 frs. (£18,862). This sum being insufficient to allow of the payment of the usual dividend of 70 frs. (£2 16s.) per share, the Directors considered themselves justified in drawing upon the liquidation account to the extent of 53,037 frs. (£2121), to make up the necessary amount, leaving the balance standing to the credit of that account 398,892 frs. (£15,956). The report and accounts were received and adopted by the general meeting of Shareholders, a Director was appointed to replace M. Du Bochet (deceased), and the retiring Directors were re-elected.

Alleged Pollution of Subsoil by the Driffield Gas-Works.—For some time past, says the *Leeds Mercury*, from facts which have recently come before the Driffield Local Board, wells or bores in the neighbourhood of the gas-works have yielded water tasting and smelling strongly of gas. Mr. Baynes, of Hull, was employed to analyze and report upon the water, which he did at the last meeting, stating that it was decidedly unfit for drinking purposes, and he should imagine it had been polluted either from the gas-works or from some very recent sewage. The Company were communicated with, and requested to abate the nuisance. At the meeting of the Local Board on Friday, the 20th inst., Mr. Jennings asked whether any reply from the Company had been received, or whether anything had been done. Receiving an answer in the negative, he proposed—"That the Clerk again write to the Secretary of the Gas Company, and ask for an immediate reply to his letter of the 9th inst., and state that, unless the nuisance complained of be forthwith abated, proceedings will be taken by the Board, under the Public Health Act, 1875, for recovery of the penalties mentioned in section 68 of that Act." After a long discussion, in which several members said that they would have voted for the whole motion had the Gas Company had more time, Mr. Jennings withdrew the latter portion of it, intimating that he should move it at the next meeting if the state of things were not improved, when he should expect those gentlemen, at whose suggestion it had been curtailed, to vote for it. The first portion of the motion was then put to the meeting and carried unanimously.

Doncaster Corporation Water Supply.—Mr. J. Smith, C.E., one of the Inspectors of the Local Government Board, held an inquiry at Doncaster on Saturday, the 21st inst., consequent on the application of the Corporation of Doncaster for extended borrowing and other powers in connection with their water supply. The Corporation propose to borrow £76,000 in addition to the £80,000 already expended on the works. They also seek powers to extend the limits of their Act, so as to include therein Bentley-with-Arksey, Denaby, Kilnhurst, Long Sandall, and Wheatley; also to make it an offence to pollute streams within the area of the gathering-ground; and, finally, to authorize the fixing of meters in places beyond the limits prescribed by the Act. Several objections were advanced, the principal one being that of the Kilnhurst Local Board, who represented that they had already arranged to supply a part of the township from some new works in connection with the Wakefield scheme, and, therefore, asked that Kilnhurst might not be included. The Town Clerk said they had no objection to this. The Corporation had been asked some time ago whether they could supply Kilnhurst, and had now simply included the place for its own benefit. Kilnhurst was, therefore, struck out. A farmer, who said he farmed 300 acres within the gathering-ground, wished to know what would be considered a pollution of the stream. It was explained that he might use manure upon his land, but not night-soil. The Inspector asked Mr. Brundell (the Engineer) if he thought £76,000 would be sufficient to complete the works. Mr. Brundell said it would not, and it was arranged to take powers for borrowing £85,000. The Inspector said that he would report upon the application in due course.

Opening of a New Gasholder at Morecambe.—A large new holder which has been in course of construction for the last seven or eight months, from the designs of Mr. W. Duff, the Engineer and Manager of the Morecambe Gas Company, was, on Wednesday, the 18th inst., brought into use for the supply of the town, the Chairman of the Company (Mr. Roper) opening the valves connecting the holder with the mains. During the excavation for the tank in March last there were numerous quicksands to contend with, and the bottom of it had to be piled. This, of course, considerably delayed the work, but ultimately these obstacles were overcome, and the work proceeded steadily until the syphon-boxes (which are 5 feet below the bottom of the tank) had to be put in, when a spring of water was tapped, which spouted out in a column of about two inches in diameter, and pumps had to be kept at work night and day to reduce the water. This obstacle was also successfully overcome, and the work proceeded without further mishap until the previous Tuesday, when the holder was filled with air to test it. The holder is 72 feet in diameter, and is constructed in two lifts of 17 feet each. It will contain 140,000 cubic feet of gas, and is four times larger than both the present holders put together. It is surrounded by eight columns of cast iron, 36 feet high, each column having a Corinthian cap near the top, with eight rows of ornamental girders. In the centre of the columns are eight other girders, the columns and girders being of a very ornamental description, and relieved with different colours of paint. The tank, constructed of cast iron, is 74 feet diameter and 17 feet 6 inches deep, and is bound together by strong wrought-iron hoops. Eight buttresses of brickwork, 4 feet 6 inches square, are carried up to the height of the tank, to support the columns. The whole of the work is of a very effective character, and reflects great credit upon its designer.

Experiment in Carburetting Gas.—We (*Dundee Advertiser*) mentioned recently that we intended to make an experiment in lighting one of the large rooms in the *Advertiser* Office, by passing the gas used through a liquid carbon, so as to test whether the same effect could be attained with all the jets supplied from one main, as is obtained with a single jet, or a cluster, by the Albo-Carbon process. Before undertaking the experiment on a large scale, we resolved to try it at a single standard light, and it is fortunate that we did so, as otherwise we should probably have choked up all the pipes in the large room. We were anxious that the trial should succeed, and authorized our plumber to adopt every suggestion likely to make it successful. The first plan adopted was to pass the gas through a small vessel, filled about one-third with naphtha; and, to assist the volatilizing of the carbon, the vessel was placed on a pipe containing warm water at about 120° Fahr. So far as the light was concerned, it was disappointing, it being difficult to detect any improvement as compared with an ordinary jet in the same room. On the second night, instead of there being any improvement, the light was much worse—jumping up and down precisely as in a bad case of "water in the pipes." It was so bad that the apparatus had to be disconnected, and it was then found that the naphtha had evaporated to some extent from the vessel, and lodged in the pipe in a liquid state, causing the light to jump up and down. Assuming that the heat of the warm-water pipe had promoted excessive evaporation, we had the vessel removed, and placed where there was no heat

above the ordinary temperature of the room; but after a time the jumping of the light began again, the gas gave off an excess of smoke, and there was a disagreeable smell of naphtha. It was now obvious that the passing of the gas through the naphtha must be given up, and on the third night the supply was carried up a second small pipe, the end of which was inserted into the gas-burner. There was now a decided enhancement of the brilliancy of the gas, quite apparent on contrasting the shadows of the ordinary gas and the jet of gas *plus* naphtha. But there was still the objection of an offensive fume. The apparatus remained attached till the fourth night, when, on the gas being lighted, it flared up for a few seconds, and then went out suddenly, the naphtha having collected in the supply-pipe. So ended our experiments, which were fairly and patiently tried, but which led us to the conclusion that it is as well to be cautious in making trials of the kind. It is only due to Mr. Livesey to say that the results have fully confirmed the warnings he gave in the letter we published from him last Saturday. Having satisfied ourselves that liquid carbons are unsatisfactory, offensive, and, indeed, dangerous, we shall, as soon as practicable, submit the Albo-Carbon process to equally careful tests.

Register of New Patents.

3434.—CAMERON, J., Salford, "*Improvements in pumps.*" Patent dated Sept. 11, 1877.

This invention is applicable to all ordinary reciprocating pumps, and consists in the addition thereto of an auxiliary valveless pump, thereby reducing the forcing strain one-half, and equalizing the flow of the water.

In carrying out the invention, the ordinary pump is connected by a link to a beam, which works on a fulcrum placed between the ordinary pump and the auxiliary pump, which is also connected to the beam by a link.

The beam is actuated by hand or power, and, consequently, imparts motion to the pumps in opposite directions; or the same alternate action may be produced by connecting the pumps to cranks or eccentrics, or otherwise.

The admission and discharge valves are of the ordinary construction, and are placed between the pumps.

The auxiliary pump is half the capacity of the original pump, and, therefore, performs half the work. The auxiliary pump receives half the water forced by the ordinary pump, and when the latter completes its stroke and its delivery-valve closes, the return stroke of the auxiliary pump forces the second half of the water into the delivery-pipe, thereby producing double action, and reducing the strain one-half.

3437.—MASSEY, G., Smethwick, "*An improved valve for pumps.*" Provisional protection only obtained. Dated Sept. 12, 1877.

This invention relates to an improvement in pump-valves, by means of which their durability is greatly increased. It consists substantially in so constructing the valve-seats that the holes or apertures provided therein, and through which the water or other fluid is caused to pass, are not in a vertical or direct line, but are pierced at such an angle with their faces that as the water or other fluid is impelled through the apertures, a rotatory motion is given to the disc or discs with which the valve-seat is fitted, and thus their positions being changed at each rise and fall of the piston, an evenness of wear throughout the whole of the disc or discs is ensured. The discs may consist of india-rubber rings, or they may be of leather or other suitable material.

3445.—EVANS, F. J., Brentford, and SUGG, W. T., Westminster, "*Improvements in the manufacture of coal gas, and in the treatment of ammoniacal liquor obtained in such manufacture.*" Patent dated Sept. 12, 1877.

The chief object of this invention is to effect the complete removal of the sulphur compounds contained in coal gas as it leaves the retorts, and thereby to increase the illuminating power of the gas.

[The invention was fully described and illustrated in the JOURNAL for May 7th last, Vol. XXXI., p. 720.]

3618.—LONGSHAW, J., Warrington, "*Improvements in the method of and apparatus for lighting street and other gas-lamps.*" Patent dated Sept. 27, 1877.

The object of this invention is to effect the simultaneous lighting of all street-lamps in a town or city, or all the gaslights in a theatre or other building or place, at one time, by means of a current of electricity.

Each gas-tap is provided with a small electro-magnet, and, by exciting all the electro-magnets at once by a current of electricity, all the taps can be opened or closed simultaneously.

The electro-magnets (which may in some cases be assisted by auxiliary permanent magnets) are all provided with wires, by means of which they are jointly connected to a battery or series of batteries at a distant point, or to any other known means of producing a strong electric current.

The lighting of the gas is effected by means of platinum wire foil or spongy platinum, assisted by an electric current, conveyed either by the same wires or by separate wires, as may be found most expedient. The platinum being so placed in connection with each tap that when the tap is opened the gas will impinge thereupon, a current of electricity is first caused to pass through the platinum, such current not being sufficiently strong to heat the platinum to any very great extent, but sufficient to impart a certain amount of warmth and thoroughly dry it and drive off all moisture. The platinum wire foil or sponge now possesses this peculiar property, that if a current of coal gas is allowed to impinge upon it whilst in this warm and thoroughly dry state, it becomes heated to such an extent that it lights all the gas. All that is required, therefore, is, first, to thoroughly dry and warm all the platinum wire foils or sponges, by passing a current of electricity throught them; and, secondly, to open the taps by the same or another electric current, and allow the gas to impinge upon the platinum in this dried and warm state; or, if preferred, the taps may be opened first, and the gas be ignited by means of an electric spark, as well understood by electricians.

3636.—MARTIN, W., Southsea, "*Improvements in water-waste preventers for closets, urinals, and similar appliances, also applicable as fluid-measuring apparatus.*" Patent dated Sept. 28, 1877.

According to this invention, water-waste preventers are constructed so as to give a flush and an after-flush by one action or up-and-down movement of the pull, handle, door, or other appliance connected with the closet, urinal, or other place to be flushed. For this purpose the pull, handle, or other actuating appliance is arranged on one side of a weigh-shaft, fulcrum, or spindle; and to the weigh-shaft on the same side of the fulcrum there is connected a rod, near the lower end of which is fixed a piston working in a cylinder, open top and bottom, and situated in a measuring-box, called the after-flush box, and carrying at its extreme lower end a valve which serves to close the outlet to the place to be after-flushed. On the opposite side of the fulcrum a similar rod is connected, fitted with a piston working in a cylinder in the flushing-box, and also fitted with a valve which serves to close an outlet to the place to be flushed. Each rod is so connected to its bottom valve that there is a so-called lost motion between them.

3651.—JOSLIN, G., Colchester, "*Improvements in gas-meter indices.*" Provisional protection only obtained. Dated Oct. 1, 1877.

This invention has for its objects the construction of gas-meter indices in such a manner that the consumer may ascertain the consumption of gas for any particular period, and set the hands on the dials at zero, whenever he pleases, without interfering with the ordinary index attached to the meter, and for providing means for testing the accuracy of the registration of such indices without necessitating the revolution or vibration of the measuring chambers of the meter.

It consists, in the first place, in attaching a train of wheels and three or more dials in connection with the ordinary index, but partially independent of it. This additional index is called the "consumer's index," and is driven by the usual gas-meter index. It is so arranged that by means of a friction or slip wheel or wheels, and a key, each pointer or hand may be turned separately, and set upon its own spindle. The consumer may therefore set the index to zero, or to any other figure or position he desires, so as to show the consumption for any given time, without altering the position of the hands or registration of the index recognized by the gas company or supplier of gas.

It consists, secondly, in providing means for disconnecting the action of the measuring chambers from the index by releasing one of the wheels or worm between the index and the measuring chambers by the tightening or slacking of a nut or screw attached thereto. The index so disengaged may then be tested without actuating the measuring chambers, by putting it in connection with a standard index driven by clockwork or other motive power, and furnished with a bell so as to give the tester notice when the revolution of the standard index is complete and has stopped. The indices may then be compared.

The opening in the case of the meter, where the connection was made between the standard index and the meter index, may be soldered or sealed up by the tester.

3706.—ANNELL, O., Stockholm, Sweden, "*Improvements in gas governors or regulators.*" Patent dated Oct. 5, 1878.

The object of this invention is to so construct gas governors or regulators that, as nearly as possible, a constant consumption of gas may be ensured, independently of the variable pressure of the gas supply, and to make the different flames independent of each other, so that the consumer may always have it in his power to determine the quantity of gas he uses for a certain purpose.

The invention consists of a shell or case made of any suitable metal, and into the top of which a piece of metal, to which the burner is fixed, is screwed. The piece of metal that carries the burner, or the steatite burner itself, has several holes through the bottom of it to admit of the passage of the gas. Within the shell or case is a short tube, open at both ends, and provided with slotted openings in its sides. This tube has also a flange at its lower end, of such diameter as will permit of its rising and falling freely within the chamber. On the under-side of the flange there is a disc pivotted eccentrically, and so arranged that it may be adjusted to cover the central orifice, either wholly or in part only.

In the upper part of the chamber is fixed a plate, with a central aperture of such a diameter as will form a guide for and allow of the short tube sliding up and down through it easily.

To the lower part of the shell is screwed another piece of metal, having a thread on its exterior, so that the governor may be screwed into the ordinary gas-fitting; or the shell may be made in one piece, the lower part being screwed as just described.

The gas enters the lower chamber, and passes through the adjustable opening into the sliding tube, and between the flange and the upper plate, and also through the upper part of the sliding tube into the conical chamber in which the several holes leading to the burner are placed.

The action of the gas upon the bottom flange, as the pressure increases in the gas-pipes, raises the moveable tube, and the outlet between the upper end of the metal tube and the bottom of the conical chamber is reduced so as to admit less gas to escape through the burner; and as the pressure decreases, it falls, thereby allowing more gas to pass to the burner.

The gas admitted between the flange and the upper plate acts as an equalizer of pressure to that on the under-side of the flange, thereby causing, as nearly as practicable, an equal flow of gas to the burner, and so secure a uniform flame, no matter what the variation of pressure in the supply-pipes may be.

APPLICATIONS FOR LETTERS PATENT.

5229.—FARLEY, J., Birmingham, "An apparatus for the heating and lighting of rooms, also applicable to gas-stoves, and other analogous purposes." Dec. 20, 1878.

5234.—LAWSON, J. S., Barnsley, Yorks, "Improvements in the construction of gas-stoves." Dec. 21, 1878.

5276.—WARNER, R. G., Jewin Crescent, and BROWN, J. J., Bunhill Row, London, "Improvements in cocks, valves, and taps." Dec. 24, 1878.

PATENTS WHICH HAVE PASSED THE GREAT SEAL.

2516.—MEAD, W., Laurence Pountney Hill, London, "An improved process for converting into caustic lime spent lime which has been used in the purification of illuminating gas." A communication. June 24, 1878.

2575.—PIEPER, C., Dresden, Saxony, "An improved water-meter." A communication. June 26, 1878.

4112.—JENNINGS, G. and G., jun., Stangate, Surrey, "Improvements in water-closets, and in traps and appliances for controlling the supply of water." Oct. 16, 1878.

4208.—SIEMENS, C. W., Westminster, "Improved means and apparatus for electric illumination." Oct. 22, 1878.

4278.—WELCH, E. J. C., Manchester, "Improvements in apparatus for dividing and distributing, or for collecting, electric currents for lighting and other purposes." Oct. 25, 1878.

PATENTS WHICH HAVE BECOME VOID

BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £50 BEFORE THE EXPIRATION OF THE THIRD YEAR.

4192.—JENNINGS, J. G., and POCOCK, A. W., "Improvements in water-waste preventers." Dec. 3, 1875.

4427.—SUGG, W. T., "Improvements in apparatus for maintaining the proper water level in station gas-meters." Dec. 21, 1875.

4428.—SUGG, W. T., "Improvements in station and test gas-meters." Dec. 21, 1875.

PATENT WHICH HAS BECOME VOID

BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £100 BEFORE THE EXPIRATION OF THE SEVENTH YEAR.

3254.—SILBER, A. M., and WHITE, F., "Improvements in apparatus for heating, cooking, and lighitng purposes." Dec. 1, 1871.

The GRAND MEDAL of MERIT at the VIENNA EXHIBITION, TWO MEDALS at the PHILADELPHIA EXHIBITION and TWO MEDALS at the PARIS EXHIBITION, have been AWARDED to GWYNNE & CO. for GAS-EXHAUSTERS, ENGINES, and PUMPS; Also 27 OTHER MEDALS AWARDED at all the GREAT INTERNATIONAL EXHIBITIONS.

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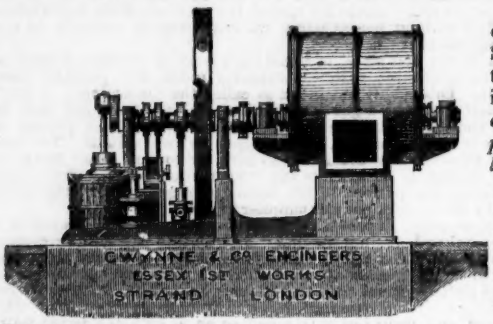

The Judges report on the combined Exhauster and Steam-Engine exhibited at the Philadelphia Exhibition is—"*Reliable compact Machine, well adapted for the purpose intended, of excellent workmanship.*"

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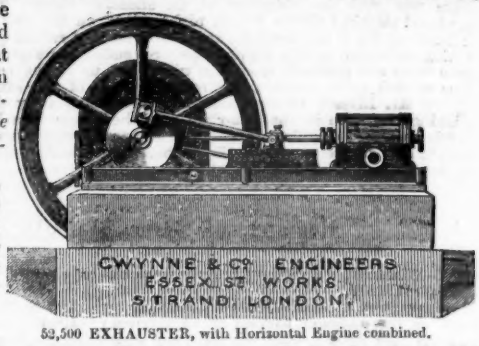

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52,500 EXHAUSTER, with Horizontal Engine combined.

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Exhausters, with or without Engines combined, can be made to pass the gas WITHOUT OSCILLATION OR VARIATION IN PRESSURE Regulators, Bye-Passes, Stop-Valves, Gas-Valves, Station Governors, and Gas Machinery of all Sizes.

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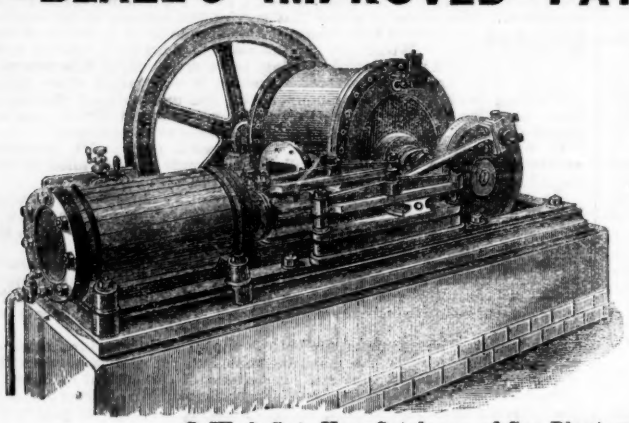

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Beg to call the attention of Gas Engineers to the fact that the novel and original feature in connection with PEEBLES' SYSTEM OF CONTROLLING THE ACTION OF GAS GOVERNORS is the loading or acting on the Bell by Pneumatic Pressure instead of Weights.

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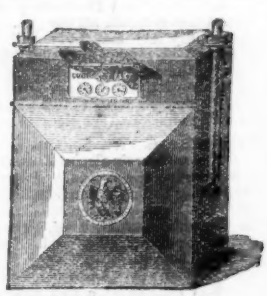

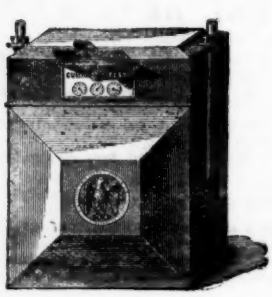

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THE Directors of the Great Yarmouth Gas Company are prepared to receive TENDERS for the Purchase of the Surplus TAR and the whole of the AMMONIACAL LIQUOR produced at their works for One year from Feb. 2, 1879.
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Sealed tenders, addressed to the Chairman and endorsed "Tender for Tar," to be sent in not later than the 4th of January next.
The Directors do not bind themselves to accept the highest or any tender.
WM. H. WILLIS, Secretary.
Gas Offices, Great Yarmouth, Dec. 16, 1878.

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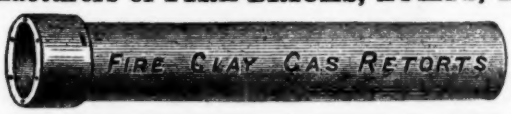

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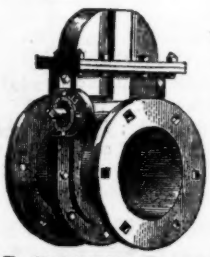

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These Valves are proved on both sides to 30 lbs. on the square inch before leaving the works, and are kept in stock.
In ordering Valves, please state whether required for under or above ground, and if to be with flanges or spigots and sockets cast on, or with separate spigot and socket pieces.

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Any further information thereon can be had from the Manager at the Works.
Tenders, endorsed "Tender for Station-Meter," must be sent to me.
By order,
ZACH. MELLOR, Town Clerk.
Town Hall, Rochdale, Aug. 2, 1878.

THE Gas Committee of the Corporation of Manchester have under consideration the desirableness of holding an Exhibition of Gas Apparatus, and they are prepared to receive Price Lists with Illustrations and detailed particulars of Gas Engines and every description of Gas Apparatus for Cooking, Heating, and Ventilation, or any other purpose.
All communications to be addressed to the Chairman of the Gas Committee on or before Jan. 31, 1879.
By order,
JOSEPH HERON, Town Clerk.
Town Hall, Manchester, Dec. 24, 1878.

TO CONTRACTORS AND BUILDERS.

THE Watford Local Board of Health are desirous of receiving TENDERS for the construction of a Brick, covered RESERVOIR, to contain about one million gallons.
Plans and specification can be seen and forms of tender obtained on and after Wednesday, the 11th of December, on application to Mr. C. C. Lovejoy, Surveyor to the Board, between the hours of ten a.m. and four p.m., at the Local Board Water-Works.
Tenders on the printed form to be delivered at my office, not later than six m.p., on Thursday, January 16, 1879.
The Board do not bind themselves to accept any tender.
By order of the Board,
JOHN SEDGWICK, Clerk.
Watford, Dec., 1878.
N.B.—Copies of the Specification can be had of the Surveyor at 7s. 6d.

BOROUGH OF BRADFORD.

EXHIBITION OF GAS-STOVES, GAS-ENGINES, GAS-BURNERS, AND OTHER APPLIANCES AND INVENTIONS FOR THE ECONOMIC USE OF GAS FOR DOMESTIC AND MANUFACTURING PURPOSES.

THE Bradford Corporation having deter- mined to hold an Exhibition of Appliances for the Use of Gas for the above purposes, are prepared to receive Applications from Gas Engineers, Manufacturers of Gas-Stoves, and others, for space for the Exhibition of their Gas Apparatus. Room and Gas, with connections, will be provided free of charge. The Exhibition is intended to commence on Monday, the 17th of February next, and continue for ten days.
Any information may be obtained on application to me at the undernamed office.
W. T. M'GOWEN, Town Clerk.
Town Clerk's Office, Town Hall, Bradford,
Dec. 23, 1878.

HENRY LYON (14 years Engineer and Manager of the largest of the Manchester Corporation Gas-Works) Mechanical and Consulting Gas Engineer, reports upon the condition and value of Gas-Works, supplies plans and specifications of all Apparatus appertaining to Gas-Works, and re-models existing Works.
Address Brooklyn, near Halliwell Lane, Cheetham Hill Road, MANCHESTER.

MR. EDWARD SANDELL,

Associate of the Society of Accountants in England,
Publisher of the
"Gas Companies Expenditure Journal,"
Begs to announce his REMOVAL from Skinner's Place, Size Lane, to
No. 2, ST. GEORGE STREET, WESTMINSTER.

Mr. ROBERT DEMPSTER, Sen.,

CONSULTING GAS ENGINEER,
Of Messrs. Robert Dempster and Sons, Rose Mount Gas Engineering Works,
ELLAND, near HALIFAX,
May be consulted on all matters connected with Valuations, Arbitrations, and Parliamentary Applications connected with Gas-Works. Our R. D., Sen., having been engaged on extensive Arbitration Cases, which, combined with his experience in Construction and Contracting, his knowledge of Engineering and Valuations, is both extensive and reliable.

GEORGE BRAY & CO.'S

NEW

Illustrated Catalogue

OF

GAS-BURNERS.

See Page 969.

ECONOMY IN THE PRODUCTION OF GAS.

PLUTONIC CEMENT,

FOR JOINTING AND REPAIRING RETORTS AND OVENS *in* ACTION AND *out* OF ACTION.

A Pamphlet on the advantages of the above, with Modes of Application, References, Prices, &c., free by post, from the Sole Manufacturer,

WILLIAM RICHARDSON, Gas and Hydraulic Engineer, CHARLES HENRY STREET, and BISSELL STREET, BIRMINGHAM.

HYDRATED PURIFYING MATERIAL.

Samples on application.

MESSRS. SPENCE BROS., LIMITED,

Will be glad to supply the above on the most favourable terms, and to treat, by Purchase or Exchange, for Spent Oxide.

PRICES ON APPLICATION.

ALSO PATENT DRY COPPERAS FOR EXTRACTING AMMONIA.

VICTORIA CHEMICAL WORKS, BRADFORD, NEAR MANCHESTER.

PARIS EXHIBITION, 1878.

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Being the Highest Honour given for this class.

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SPECIAL NOTICE.—Our Patent Machine-Made Retorts have now been thoroughly tested, and have proved themselves infinitely superior to those made by hand. At several large works it has been settled, beyond question, that, owingto their compactness and general excellence, more gas is sent to the gasholder from each ton of coal carbonized than is the case with hand-made Retorts.

Now Ready, price 28*s., handsomely bound in Morocco, cloth sides, gilt edged and lettered,*

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ON THE

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COAL GAS.

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This Volume contains 460 pages of Letterpress, and is illustrated by 521 Woodcuts and 36 page and double-page Engravings, printed on Plate paper, and a full-page

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Forming a Frontispiece to the Volume.

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WALTER KING, 11, BOLT COURT, FLEET STREET, LONDON, E.C.

GAS PURIFICATION

BY

OXIDE OF IRON.

COOKE BROTHERS

Beg to draw the attention of Gas Companies to the following certificate, relative to the quantity and quality of their Oxide, from the Assistant Surveyor of the County of Donegal:—

"*Londonderry, Oct.* 12, 1878.

"I have examined some of the deposits of iron ore in the following localities in the county of Donegal, over which Messrs. Cooke Brothers hold exclusive royalties for raising the ore—namely, several townlands in the Barony of Kilmacrenan, including the estate of Viscount Southwell, in the Barony of Raphoe, the estates of Sir Samuel Hayes and Colonel Montgomery, in the Barony of Ennishowen, several townlands on the estate of Mr. Newton—and I certify that the several estates are rich in Oxide; that the ore is of a very good quality, such as is usually shipped from this county; that the districts, which are very extensive, are capable of producing a large supply; in fact, the supply of ore on these estates is practically inexhaustible.

(Signed) "PHILIP M'LAUGHLIN, *Assistant County Surveyor.*"

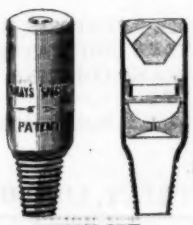
COOKE BROTHERS beg to state they are also in possession of several other exclusive sources of supply, independent of those included in the above certificate.

26, 27, *and* 28 *Fenchurch Street, London, E.C., Oct.*, 1878.

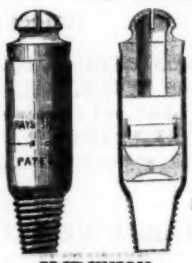
DESCRIPTIVE CATALOGUE
OF
BRAY'S "ENAMEL" GAS-BURNERS.

In presenting this Catalogue, we wish it to be known that we are the only Manufacturers in Great Britain of Non-Corrosive Slit-Union Burners. We make them under Patents taken out here, and in several Foreign countries, of our own material, "Enamel," which is much harder and less brittle than "Steotite" (of which the imported Slit-Unions are made), and, therefore, less liable to fracture. We may also state that our burner factory is the most extensive in the World, and the only one in which composite Non-Corrosive Gas-burners are made *in all their parts*,—facts which give us the power of meeting the various requirements of gas illumination in a way that cannot be accomplished by those who make up burners from parts which are purchased from widely scattered sources.

BRAY'S "SPECIAL"



All these Burners are stamped with Trade Mark as shown in wood cut.



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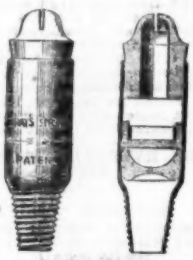

UNION-JET. SLIT-UNION. BAT'S-WING.

We believe our "Special" Burners, as improved, are more adaptable to the requirements of gas illumination than any now before the public. They can be made to suit any pressure or quality of gas (including air gas), give a well-shaped and steady flame, the gas inlet is so placed that it cannot be tampered with, and they are not liable to get out of order.

TWO DISTINCT CLASSES of burners are made, as regards lighting power—viz., for "*Highest Lighting Power*," *and* "*Medium Lighting Power*."

THE HIGHEST LIGHTING POWER CLASS are made to develop the greatest possible amount of light as tested in the Laboratory, and they surpass those supplied by any other maker or dealer, whatever the price charged. When this class is required, it must be distinctly stated so when ordering, at the same time giving quality of gas, and consumption required.

THE MEDIUM LIGHTING POWER CLASS are those which our experience leads us to recommend for general use, in preference to any which yield in the Laboratory the highest lighting power. The latter, whoever they are made by, will always be within, or near, the smoking point, and smoke freely with the slightest atmospheric commotion. To avoid the evils arising from these features, we recommend our medium lighting-power burners, the flames of which are kept well away from the smoking point, and are made to withstand atmospheric commotion better than the other class; and will do good service at a lower pressure, and give, we doubt not, *in general use*, as much light. All our "Special" burners are sent out of "Medium Lighting Power Class," unless otherwise ordered.

THE SIZES OF BURNERS are from No. 0 to 9 inclusive.

FOR SIXTEEN-CANDLE GAS (or 14 to 18 candles), the sizes from No. 4 to 9, inclusive, are those which yield the best results from 4 feet of gas and upwards; the lower numbers are for less consumptions.

FOR TWENTY-CANDLE GAS (or 19 to 22 candles), the sizes from No. 3 to 8, inclusive, yield the best results from 3 feet of gas and upwards; the lower numbers being for less consumptions.

FOR TWENTY-FIVE CANDLE GAS (or 23 to 27 candles), the sizes from No. 4 to 9, inclusive, yield the best results from 2½ feet and upwards. When burners are required for this quality, "for Cannel gas" must be distinctly stated when ordering.

FOR OTHER QUALITIES OF GAS (including air gas), burners are made to order.

PRESSURE. All our "Special" burners are made (unless otherwise ordered) to give a suitable spread of flame at five-tenths pressure, and keep in good shape up to twenty-tenths; but we make to order suitable for any specified pressure up to forty-tenths.

STREET-LAMPS. For this purpose these burners are of exceptional value. Those suitable for consumptions of, say, 3, 4, or 5 feet per hour may be made to consume that quantity at any specified pressure from five-tenths to forty-tenths; therefore, a selection of burners may be had, adapted to the several pressures of a town, by the use of which the consumption in the lamps may be balanced with a nicety not equalled by the ordinary working of governors, with the further great advantage of a reduced consumption, when the light is not required, by the usual reduction of pressure in the street-mains at midnight. In ordering for this purpose, it is necessary to state the quality of gas, the consumption, and the number of burners required for each pressure. Extended particulars on this subject will be supplied on application.

FITTINGS. We make our burners to suit the fittings of any country, but, unless otherwise ordered, they are sent out English taper-screw.

FOR GLOBES, the "Bat's-wings" are not suitable, the "Union-Jets" and the "Slit-Unions" are.

BRAY'S "ENAMEL" REGULATORS.

All these Burners are Stamped "Bray's Patent Enamel Regulator," as shown in wood cut.

All these Burners are Stamped "Bray's Patent Enamel Regulator," as shown in wood cut.

UNION-JET. SLIT-UNION. BAT'S-WING.

THE NAME "Regulator" was given to these burners when introduced eleven years ago, because burners having a medium in their interior for gas to pass through, had then become known as "Regulators." Our Union-Jets and Bat's-wings were originally introduced (and now the Slit-Unions are added) to remove two defects in the common metal burners—corrosion and roaring flames,—and our enterprise has been so far successful that the metal burners have been almost supplanted. A steady well-shaped flame is produced by the combined excellence of the tip and the medium through which the gas has to pass in the interior of the burner.

LIGHTING POWER. Though their lighting power is not equal to the "Specials," nor so much under control, yet they are far superior, in this respect, to the common metal burners, with which they closely correspond in price.

THE SIZES are, in Union-Jets and Slit-Unions, Nos. 0 to 8, in Bat's-wings, Nos. 0 to 10 inclusive.

BRAY'S "ENAMEL" NON-REGULATOR.

These are similar burners in outward appearance to the Regulators, but somewhat less, and are without the interior regulating medium. Though they do not prevent the roaring and flickering, as the regulators do, they are excellent burners at the price charged. Our name is not stamped on these burners.

THE SIZES are, in Union-Jets and Slit-Unions, Nos. 0 to 8, and in Bat's-wings, Nos. 0 to 10 inclusive.

BRAY'S MARKET BURNERS.

These are Bat's-wings of unusually large size, and are admirably adapted for markets, butchers, and any purpose for which an immense flame is essential.

THE SIZES ARE Nos. 19 and 20.

All these burners are stamped "Bray's Market Burner," as shown in wood cut.

The RAT'S-TAIL or ONE-HOLE BURNER.

This burner shoots out a straight jet, like a rat's tail, and is used to some extent in Scotland for illuminating purposes; and there, as elsewhere, for heating, cooking, pipe lighting, and other purposes.

THE SIZES kept in stock are Nos. 0 to 6 inclusive, but any other size is made to order.

Every Description of Gas-Burner not herein mentioned made to order in "Enamel."

GEO. BRAY & CO., BLACKMAN LANE, LEEDS.

WANTED, Readers of the Pamphlet, "Cooking and Heating by Gas;" on Burners, &c. Copies, by post, Threepence, direct from the Author, MAGNUS OHREN, Gas-Works, SYDENHAM, S.E.

MICHAEL AND WILL'S GAS AND WATER SUPPLY. Second Edition, 8vo., 23s. cloth.

THE Law relating to Gas and Water. Comprising the Rights and Duties as well of Local Authorities as of Private Companies in regard thereto, and including all legislation to the close of the last session of Parliament. Second Edition. By W. H. MICHAEL and J. SHIRESS WILL, Esqs., of the Middle Temple, Barristers-at-Law.
London: BUTTERWORTH'S, Her Majesty's Law Publishers. 7, FLEET STREET.

THE ELECTRIC LIGHT.
LETTERS ADDRESSED TO THE EDITOR OF THE "JOURNAL OF GAS LIGHTING," &c., BY
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Mr. F. W. HARTLEY, A. Inst. C.E., M.S.E., &c.
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AN increased yield of gas, and of augmented illuminating power, is obtained by employing WHITE'S AUTOMATIC VALVE, and dispensing with the Hydraulic Main, the tar of which, as is well known, absorbs the rich constituents of the gas, consequently, diminishes alike the quantity and quality.
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A Pamphlet descriptive of the above method, post free, 6½d.

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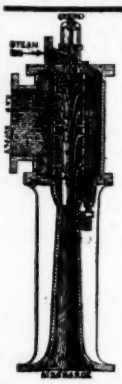

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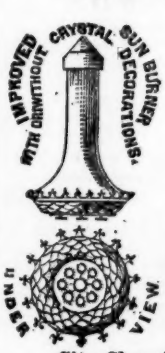

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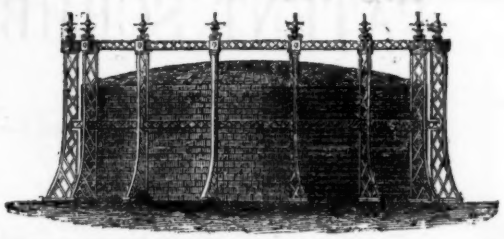

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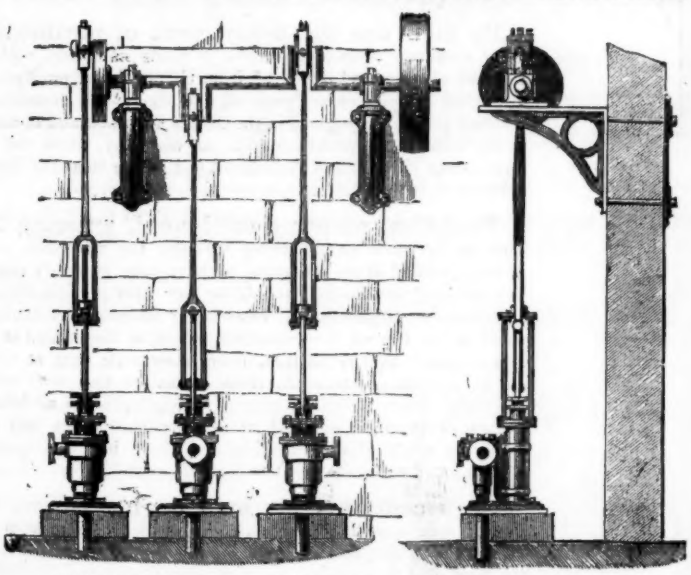

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For Water. For Tar. For Ammoniacal Liquor.

This Illustration shows an arrangement of three (No. 179) Improved Double-Action Pumps driven from the same crank-shaft, as frequently supplied for use in Gas and Chemical Works. The suction and discharge pipes can be arranged for drawing from and delivering in any required direction.

These Pumps have been supplied to nearly all the large Gas Companies and Chemical Works, both for Pumping Water, Tar, and Ammoniacal Liquor.

AS SYPHON PUMPS, IN COPPER OR SHEET IRON, ALWAYS IN STOCK.

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Tarred & White Spun Yarn for Pipe Joints, at various prices.
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MANUFACTURERS OF

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Also Makers of all kinds of Common Building Bricks, and of Pressed White and Red Bricks for Facing.

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TAR DISTILLERS & MANUFACTURING CHEMISTS,

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BRANCH WORKS, BLACKBURN.

BUYERS OF COAL TAR,

And Crude Products therefrom,

AMMONIACAL LIQUOR, &c.

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CHESTER-LE-STREET, DURHAM.

Manufactory for every description of Casting and Machinery for Gas-Works and Water-Works.

Warehouse in London for Cast-Iron Pipes and Connexions of all sizes and in any quantity, Scott's Wharf, Bankside, Southwark.

Agent in London, Mr. J. MANWARING, 101 Cannon Street, E.C.

JAMES OAKES & CO.,

ALFRETON IRON-WORKS, DERBYSHIRE,

AND

WENLOCK IRON WHARF, 21 & 22, WHARF ROAD, CITY ROAD, LONDON, N.,

Keep in London and at their works large stocks of PIPES and CONNEXIONS (1¼ to 36 inches in diameter); also make and supply Retorts, Tanks, Columns, Girders, Special Castings required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

CHARLES HORSLEY, Agent.

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Manufacturers of THE ORIGINAL SILICA OR DINAS FIRE-BRICKS. Specially adapted for Gas-Retort Furnaces and for Siemens's Gas-Furnaces. Shipments promptly executed to London, Liverpool, Hull, Grimsby, &c.

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BEST STOURBRIDGE FIRE-BRICKS, LUMPS, AND CLAY RETORTS

Of all Dimensions for Gas-Works,

GLASS-HOUSE POTS & CRUCIBLES

Of every kind.

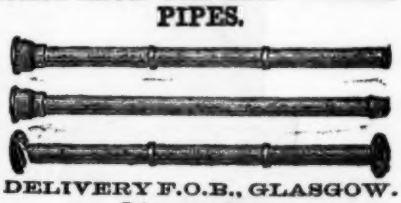
The Highest Award was obtained by H. & M., at the Philadelphia Exhibition, 1876, for Superior Quality of Manufacture.

GAS AND WATER PIPES.

WILLIAM MACLEOD & CO.,

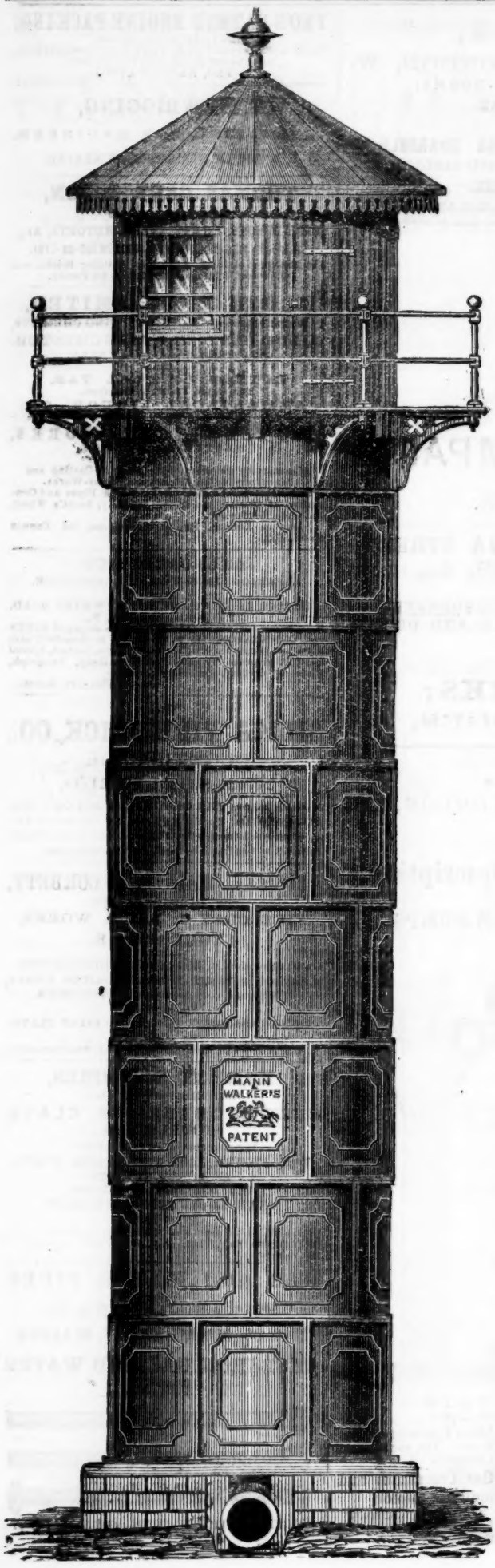
23 & 25, OSWALD STREET, GLASGOW.

CAST-IRON GAS AND WATER PIPES.



DELIVERY F.O.B., GLASGOW.

Prices on application.



C. & W. WALKER,
8, FINSBURY CIRCUS,
LONDON, E.C.

MANN & WALKERS' PATENT SCRUBBER.

By Letters Patent in Great Britain, Europe, and the United States of America.

By some important improvements recently patented, the purifying power of these Scrubbers has been much increased, and a stronger ammoniacal solution obtained, which is found to absorb a large portion of the carbonic acid contained in gas, effecting an important saving in money and labour in the lime purifiers, and where oxide only is used, the increase in the illuminating power of the gas obtained by these Scrubbers is shown in a remarkable degree, in consequence of the large quantity of carbonic acid removed from the gas.

It is to be particularly noted that the important results of these Scrubbers do not depend upon the machinery alone. The entire internal construction of the Scrubber bears an almost equally important part. For this reason, where it is desirable to convert existing Scrubbers, whose dimensions happen to be suitable, the work commences by ripping out the whole of the interior of the shell, and beginning the internal construction *de novo* from bottom to top.

Fifty million cubic feet of gas per 24 hours are purified from ammonia by these Patent Scrubbers in a winter's day in the gas-works of London, where the purity of gas supply is the highest in the world, under the chemical restrictions of the Board of Trade.

Generally, wherever a high standard of purification is maintained in the chief cities and towns of the British Provinces and of Europe, these Scrubbers have become established.

By their use the department of purification from ammonia upon a gas-works is made complete, without the aid of prepared oxide of iron, chemicals in purifiers, or any other supplementary process, and the whole ammoniacal residual product contained in the coal is absorbed and obtained in the form most profitable to a gas company, while the requirements of all Acts of Parliament and of the Board of Trade, relating to incorporate gas companies, are satisfied.

Foul Gas, properly condensed, entering the inlet is, by once only passing through the Scrubber, completely purified from ammonia with regular certainty day by day, without any further trouble, or any other process, effected by a very small quantity of clear water let into the machinery room at the top of the Scrubber, which is discharged at the liquor outlet at the bottom, from Newcastle coal at about 18 to 20 ounces strength, from Yorkshire and other coals, generally from 25 to 30 ounces strength; while acidulated litmus or turmeric exposed at the Scrubber outlet will not show the slightest discoloration, and there is not a quarter of a grain of ammonia per 100 feet left unabsorbed.

They contain their own engine power, requiring only a small inappreciable quantity of steam from the gas-works boiler, and are then complete in themselves, ready for service.

Applications relating to dimensions and prices should be addressed to us, C. AND W. WALKER, 8, FINSBURY CIRCUS, LONDON, E.C., or to Mr. WILLIAM MANN, late Superintendent of the Chartered Gas-Works, BLACKFRIARS, LONDON; they should state approximately the largest make of gas in 24 hours or a winter's day, and the smallest make on a summer's day, to be purified.

THE

ONLY TWO GOLD MEDALS

FOR

GAS-BURNERS & GAS-METERS,

BRITISH SECTION,

PARIS EXHIBITION,

1878.

The International Juries of the Paris Exhibition have awarded to

WILLIAM SUGG,

GAS ENGINEER,

VINCENT WORKS, VINCENT STREET,

WESTMINSTER, S.W.,

ONE GOLD MEDAL, Class 27,

FOR HIS

PATENT GAS-BURNERS, PATENT LAMP-GOVERNORS,

AND

PATENT CONSUMERS DRY GOVERNORS;

AND ALSO

ONE GOLD MEDAL, Class 53,

FOR HIS

PATENT ILLUMINATING POWER METERS,

IMPROVED JET-PHOTOMETERS, PHOTOMETER METERS,

AND

IMPROVED COMPENSATING WET METERS

WITH

SIMPLE INDEX.

Prices and Particulars on application to

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198, ST. VINCENT STREET, GLASGOW.

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LOTHIAN'S CANNEL

Yields 12,500 cubic feet of 34-candle gas per ton, and 9 cwts. of excellent coke, containing only 4 per cent. of ash.

MUIRKIRK, No. 1, CANNEL

Yields 12,160 cubic feet of 32·5-candle gas per ton, and 10 cwts. of excellent coke, containing only 5 per cent. of ash.

OLD WEMYSS CANNEL

Yields 13,320 cubic feet of 32·5-candle gas per ton.

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GAS COAL.

POPE & PEARSON, LIMITED, have now the authority of several of the most eminent Gas Engineers of London in stating that their Coal yields *in practical working over* 10,000 *cubic feet of gas, with an illuminating power of* 16 *candles;* or by the standard burners now used by the London Gas Companies, an illuminating power equal to 17½ candles.

One ton yields 12½ cwt. of good coke. This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.

For further particulars, apply to POPE AND PEARSON, LIMITED, West Riding and Silkstone Collieries, near LEEDS.

SCOTCH CANNEL COALS.

The Subscriber is prepared to contract for the supply of all the principal SCOTCH CANNEL COALS. Prices and Analyses of the various Coals will be forwarded on application.

JAMES M'KELVIE,

CANNEL COAL MERCHANT,

HAYMARKET, EDINBURGH.

Established 1840.

DEAN'S PRIMROSE GAS COALS.

South Metropolitan Gaslight and Coke Company, London, July 12, 1878.

The Owners of the Dean's Primrose Colliery.

Dear Sirs,—I have much pleasure in stating that this Company have regularly used your Coals for more than thirty years, and that in all essential particulars they give the most satisfactory results.

The yield of Gas is from 9700 to 9800 feet per ton, of full 16 candles illuminating power, tested by the London Referees Standard Burner; and the Coke is of very good quality, while the quantity is about 40 bushels to the ton of Coal.

I consider Dean's Primrose Coals to rank amongst the first-class Gas Coals from the Durham Coal-Field.

Yours truly, GEORGE LIVESEY.

These Coals are also used by The Gaslight and Coke Company (London), and other English and Foreign Gas Companies.

Steamers loaded with quick despatch in the River Tyne.

Price and other terms on application at the

FITTING OFFICE, NEWCASTLE-ON-TYNE.

HOLMSIDE GAS COALS.

South Metropolitan Gaslight and Coke Company, 589, Old Kent Road, London, S.E., Oct. 9, 1873.

At the request of Mr. Hedley, the owner of the Holmside Colliery, I have much pleasure in stating that, for about ten or twelve years past, this Company has taken at least half of its supply of Newcastle Coal from him. I can, therefore, confidently bear testimony to the good quality of the Holmside Coals, and consider they are equal to the best of the Newcastle Coals, in proof of which I may state that this year we are using those Coals exclusively, that the yield of Gas is from 9700 to 9800 feet per ton, and that the quality of the Gas, without any admixture of Cannel, is over 16 candles, as tested by the officer appointed by the Metropolitan Board of Works, using the London Gas Referees test.

The Coke is of excellent quality, and in quantity amounts to about 40 bushels from a ton of Coal.

The annual consumption of Coal amounts to about 75,000 tons.

GEORGE LIVESEY, Engineer and Secretary.

P.S.—I am at this date, Feb. 15, 1875, still using Holmside Coals as largely as ever, and am quite as well pleased with them as when I gave the above certificate.

GEORGE LIVESEY.

We are this year, 1878, using 80,000 tons of Holmside Coal. GEORGE LIVESEY.

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M. BREMOND'S NAPHTHALINE PROCESS.

A negotiations respecting M. Brémond's patented process for preventing Deposits of

NAPHTHALINE

in Gas Main and Service Pipes should be addressed to Mr. W. H. BENNETT, 22, Great George Street, WESTMINSTER, S.W., or to M. BREMOND, Gas Engineer, Compania Madrilena de Alumbrado y Calefaccion por Gas, MADRID, who may be consulted upon all matters connected with the Gas Industry.

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AGENT FOR

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AND

NEWTON, CHAMBERS, & CO.'S SILKSTONE GAS COALS.

Analyses and Quotations on application.

WILSON CARTER AND PEARSON,

GAS COAL AND CANNEL FACTORS,

Supply to any Railway Station or for Export all kinds of Fuel for Gas purposes.

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PATENTEE and MANUFACTURER of the following Invention

RETORT SETTINGS—giving great Economy of Fuel.

STEAM-ENGINES and EXHAUSTERS, FOUR-WAY VALVES, WASHERS, SCRUBBERS.

FUEL-MACHINE, for Compressing Breeze and Tar.

N.B.—Pamphlet, with Eighteen Illustrations and Letterpress on the Construction of Gas-Works, post free, 2s. 6d.

PRICES AND ALL PARTICULARS TO BE HAD OF THE PATENTEE,

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J. & J. BRADDOCK,

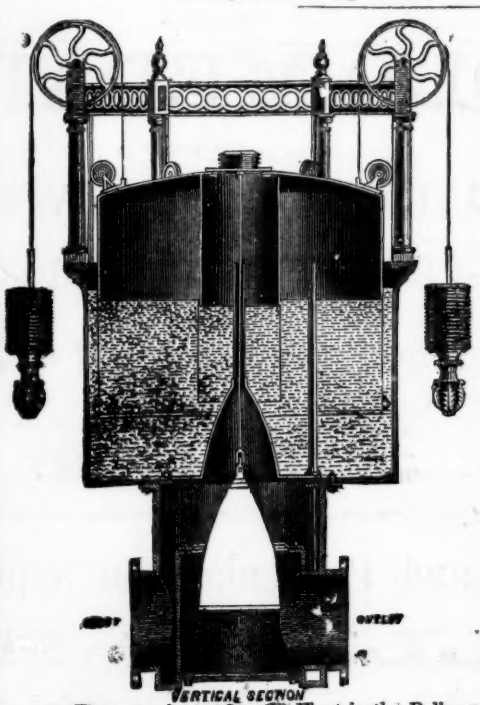
GLOBE METER-WORKS,

OLDHAM,

Beg to submit to Gas Engineers their

PATENT COMPENSATING GAS GOVERNOR,

Which is designed to give an uniform pressure at the Outlet to the Main at all draughts up to the full quantities which the Governors are made to control, such outlet pressure being less than the initial pressure.



The uniformity of pressure is obtained by introducing a compensating chamber into the Bell or Holder of the Governor, which compensator is of the same area as the valve, both of which are operated on by the initial pressure, thereby placing the valve in equilibrium, no matter what the initial pressure may be. The action on the Bell is by the Gas passing along a pipe from the outlet, and the pressure is regulated by weights in connexion with the Bell as required.

From the sectional elevation attached hereto, it will be seen that only the Gas required to operate the Bell comes in contact with the water of the tank, which water will remain comparatively sweet and free from odour. That in case of accident to the Bell, no more Gas can escape than would pass up the pipe covering the valve-rod and Bell supply-pipe.

These Governors have been made and sent out of various sizes for from 2 to 24-inch Mains, and give most satisfactory results.

They can be made with Float in the Bell, or counterpoise as per section.

THE SILKSTONE & DODWORTH COAL & IRON COMPANY, LIMITED,

DODWORTH, BARNSLEY.

BENJAMIN WHITWORTH, Esq., M.P. . . . . Chairman.
Mr. RICHARD HARTLEY . . . . . Managing Director.

REAL OLD SILKSTONE GAS COAL.

JAMES PATERSON Esq., Gas Engineer, of the Warrington Gas Company, reported, Aug. 10, 1875:—

"This Coal possesses remarkable qualities as a gas and coking coal, and appears SECOND TO NONE IN THE KINGDOM. It contains the large quantity of 699 lbs. of illuminating matter, and 1498 lbs. of coke to the ton, and produces **12,240** cubic feet of 16·66 candle gas."

The above Company are raising nearly a thousand tons of the Real Old Silkstone Gas Coal per working day.

PRICES QUOTED TO ANY RAILWAY STATION, OR F.O.B. HULL, GRIMSBY, GOOLE, KEADBY, LIVERPOOL, AND FLEETWOOD.

RICH. H. TAUNTON & HAYWARD,

MANUFACTURERS OF

WROUGHT-IRON GAS, WATER, & STEAM TUBES & FITTINGS,

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SULPHATE AMMONIA.

R. W. WALLACE & CO.,

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Are Buyers of SULPHATE AMMONIA in Large or Small Quantities, or Sell on Commission for Gas Companies and Makers.

PLANT ERECTED ON THE LATEST AND MOST APPROVED PRINCIPLE.

AGENTS to THE GASLIGHT AND COKE COMPANY, LONDON, for the SALE of SULPHATE AMMONIA. Works: BECKTON.

ARBITRATIONS VALUATIONS ASSESSMENTS
ROBT. DEMPSTER & SONS CIVIL ENGINEERS LONDON
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GAS ENGINEERS, IRONFOUNDERS, AND CONTRACTORS,

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MANUFACTURERS OF EVERY DESCRIPTION OF

GAS APPARATUS;

CONTRACTORS FOR THE

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Plans and Specifications Prepared, and Illustrated Catalogues forwarded on application.

NEWTON, CHAMBERS, & CO.,

THORNCLIFFE IRON-WORKS AND COLLIERIES,

NEAR SHEFFIELD.

CELEBRATED SILKSTONE GAS COALS.

The various descriptions of Gas Coal produced from the above Collieries possess an unequalled reputation, combining in a large degree the constituents essential for the production of the best quality of Coke and Gas of a high illuminating power.

A recent extensive development of the Collieries enables us to offer increased supplies.

JAS. PATERSON, Esq., of Warrington, after testing various qualities of our Coal, has sent the following testimony of their merits:—

"Warrington Gaslight and Coke Company,
Offices, Mersey Street, Warrington, April 23, 1877.

"MESSRS. NEWTON, CHAMBERS, AND CO.,

"GENTLEMEN,—After carefully testing the various samples of Gas Coals sent from your Collieries for analysis, I have pleasure in reporting them as belonging to the highest class of Gas and Coking Coals.

"The average of Nine samples gives a yield of **12,500** cubic feet of **15½**-Candle Gas, being equivalent to **664** lbs. of sperm per ton, and **1420** lbs. of fixed carbon of a very superior quality. All the samples bear a close relation to each other in value.

"Yours truly, "JAMES PATERSON."

Full particulars will be sent on application to us—address as above.

CROLL'S
DRY GAS-METERS,

PRIZE MEDALS. (INVENTED & PATENTED IN 1844,) PRIZE MEDALS.

LONDON, 1851; NEW YORK, 1853 PARIS, 1855. COMBINING ALL THE LATEST IMPROVEMENTS, LONDON 1862; DUBLIN, 1865; PARIS, 1867

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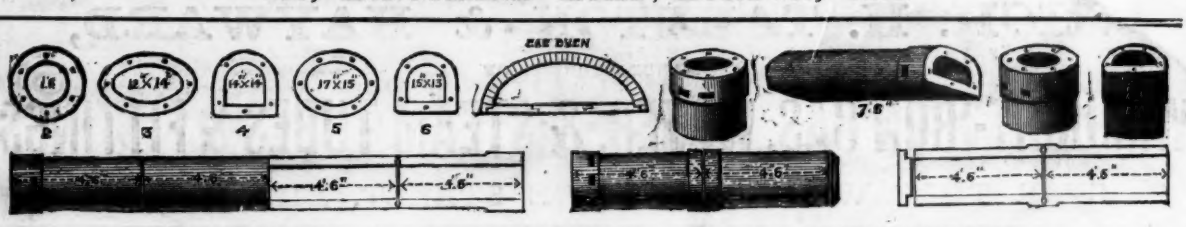

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Proprietors of Best Clay Mines. Largest makers in the World of Gas-Retorts, Lumps, Tiles, Fire-Bricks, and Fire-Clay Goods of all kinds. 200,000 feet of Gas-Retorts of all Sizes and Patterns in Stock, all in good order. Orders for any Size executed on receipt.

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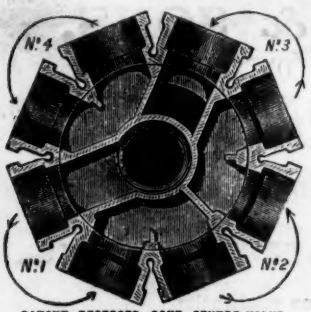
RECESSED CONE CENTRE-VALVES,

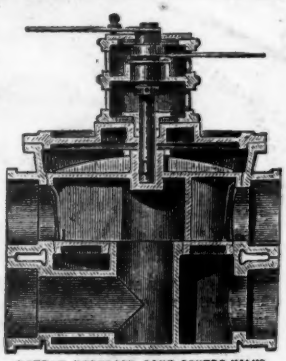
Constructed on the principle of the ordinary Plug-Cock.

THROUGH-WAY & FOUR-WAY COCKS

Of all descriptions.



PATENT RECESSED CONE CENTRE-VALVE.
Sectional Plan.



PATENT RECESSED CONE CENTRE-VALVE.
Sectional Elevation.

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D. HULETT & CO.

Invite the attention of Gas Companies, Corporations, and others to their

PATENT STREET LAMPS,

Which are so constructed that neither putty nor other materials are required to secure the glass. No hacking out of old putty, which frequently destroys the frames. A new pane of glass can be inserted in two or three minutes by any inexperienced person, the glass being secured by a hinged flap and turn button.

PRICE 10s. each, net. Special quotations for large quantities.
Also made **EXTRA STOUT** recommended for its durability, PRICE 11s. 6d. each.

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By the use of which stoppages in service and other pipes are freed from naphthaline and other obstructions in a few minutes. PRICE 73s. net.

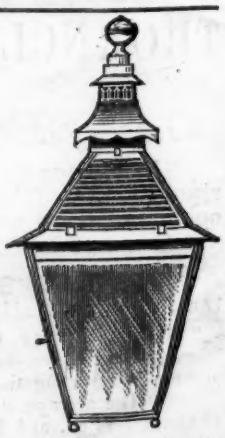
HULETT'S PATENT MERCURIAL REGULATOR,

For inserting in mains, to prevent the excess of pressure in high ground, or other elevated positions.

PATENTEES OF IMPROVED WET AND DRY GAS-METERS.

Makers of all kinds of Pressure-Gauges, Gaseliers, and every kind of Gas-Fittings for the Trade.

GAS HEATING AND COOKING STOVES.



55 and 56, HIGH HOLBORN, LONDON

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